



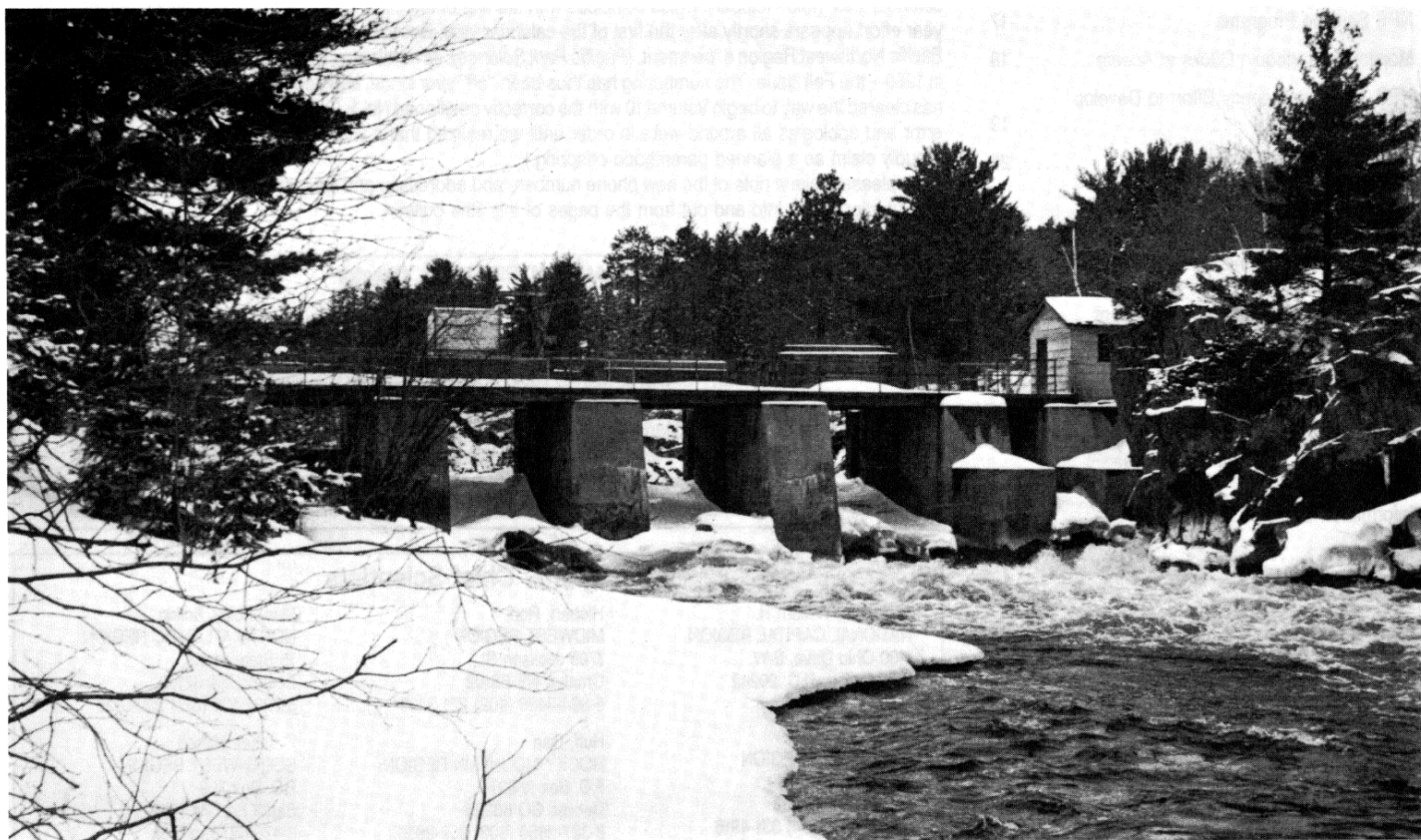
PARK SCIENCE

A RESOURCE MANAGEMENT BULLETIN

NATIONAL PARK SERVICE
U.S. DEPARTMENT OF THE INTERIOR

VOLUME 10 – NUMBER 1

WINTER 1990



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FLASH – Winners of the Director's Awards:

For Science, Charles Stone of Hawaii Volcanoes National Park

For Natural Resource Management, Jeri Hall of George Washington Memorial Parkway

★ ★ ★ ★

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Editorial

In lieu of an editorial, this space will be devoted to "good housekeeping."

First, please welcome Supt. Harold Smith of Organ Pipe Cactus National Monument, Ajo, Arizona, to the *Park Science* editorial board, where his energetic and knowledgeable presence will fill the hole so sorely empty since the retirement of Bill Lukens from the Padre Island National Seashore superintendency. We have missed Bill's input and are delighted to have the benefit of another superintendent's point of view. Thanks so much, Harold, for acquiescing to our invitation.

Second, there is the matter of change of editorial office space and address. I am no longer stationed in the Forestry Sciences Lab at Oregon State University, but am now working at 4150 S.W. Fairhaven Drive, Corvallis, OR 97333. The new phone number is (503)758-8503. If a man answers, don't hang up. It will be an invitation to leave a message, and I will return all calls promptly if I'm not here to answer them in person.

(Also please note the change of phone numbers for the Southwest Regional Chief Scientist.)

Finally, there is the matter of publication numbering, which probably went by unnoticed by most of you. But on the off chance that any of you were puzzled by "Volume 9 No. 5," (heretofore there have been only Nos. 1, 2, 3, and 4 per volume), the extra number (5) for Volume 9 now brings us into synch with both the fiscal years and the calendar years. (A neat trick.) The Winter issues, always carrying the new year's date, begin production at the end of the calendar year (mid-October), which coincides with the first of the fiscal year, so that the product of the early fiscal year effort appears shortly after the first of the calendar year. Because *Park Science* began eight years ago as a Pacific Northwest Region experiment, (*Pacific Park Science*), its numbering began with the first issue that appeared in 1980 – the Fall issue. The numbering has thus been "off" ever since, and adding a fifth number to Volume 9 now has cleared the way to begin Volume 10 with the correctly positioned No. 1. (Actually, the whole thing was an editorial error and apologies all around were in order until we realized that it was a serendipitous mistake that we could proudly claim as a planned parenthood offspring.)

So please make a note of the new phone numbers and addresses and we can look forward to an uninterrupted flow of information into and out from the pages of this little bulletin.

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Cover: Kettle Falls Dam at Voyageurs NP (see story pages 3 and following).

Reducing the Impacts of Regulated Lake Levels On the Aquatic Ecosystem of Voyageurs NP

By Larry W. Kallemeyn

The U.S. Congress, in establishing Voyageurs NP, specified that the NPS would carry out its traditional preservation role within an established water regulatory system ... a system that has severely disrupted the natural hydrologic cycle and has presented an environmental challenge ever since it was implemented. Thus, in 1975, the NPS became one of many interest groups concerned with the regulation of Rainy Lake and the Namakan Reservoir lakes, which are a part of the larger Lake of the Woods watershed.

Located approximately 300 miles north of Minneapolis, along the Minnesota-Ontario border, Voyageurs NP consists of 342 square miles, approximately 85,000 acres of which is covered by water. Since the early 1900s about 96 percent of the water area now included in the park has been controlled by dams that lie outside the park boundary. A dam at International Falls, Minn./Fort Frances, Ontario, which includes a hydropower facility, controls lake levels in Rainy Lake (Fig. 1). Regulatory dams at Kettle and Squirrel Falls control lake levels in Namakan Reservoir, which includes Kabetogama, Namakan, Sand Point, Crane, and Little Vermilion Lakes. The latter two lakes are outside the park. While all these lakes existed as natural water bodies, the present day reservoirs are larger and regulated to satisfy many water users.

Since the park lakes are international waters, shared with Canada, they are regulated by the International Joint Commission (IJC). Legally recognized water uses are navigation, sanitation, domestic water supply, power production, recreation, and other public purposes. Although the dams are regulated by the IJC, they have always been owned and operated by private industry. The day-to-day operation of the dams and reservoirs is usually left up to the industry, the IJC only becoming involved if its rules are not or cannot be followed.

With the IJC's existing water management programs, larger-than-natural fluctuations on Namakan Reservoir are used to maintain less than natural fluctu-

ations on Rainy Lake. Namakan Reservoir's average annual water level fluctuation is about 2.7 m* while Rainy Lake's is about 1.1 m (Fig. 2). The fluctuation of Namakan Reservoir is about 0.9 m greater than the estimated natural or pre-dam fluctuation while Rainy Lake's is about 0.8 m less (Flug 1986). Namakan Reservoir's overwinter (October to April) drawdown is approximately 2.0 m greater than the estimated natural fluctuation for this time period while Rainy Lake's is about the same as it would be under natural conditions. The timing of the fluctuations also is different under the regulated system. Regulated lake levels on Namakan Reservoir usually peak in late June or early July rather than late May or early June as they did prior to dam construction. They then remain stable on both Rainy Lake and Namakan Reservoir throughout the summer instead of slowly declining.

Concerns about the effects of regulated lake levels on the aquatic biota, particularly the fish community, have existed ever since the dams were constructed. However, establishment of the park, with its emphasis on restoring and preserving the natural environment and archeological resources, heightened those concerns, particularly in regard to effects of the regulated lake levels on the aquatic ecosystem (Cole 1979, 1982).

Research Program

A research program was initiated by NPS to assess impacts of the regulated lake levels on the park's aquatic ecosystem and to develop alternatives to the present water management program (Kallemeyn 1983). The first component of the program consisted of studies of the effects of present water management on species and communities thought to be sensitive to changes in water levels. The studies were carried out by researchers from several universities and the NPS (Table 1). Additional studies conducted to obtain baseline information pertinent to the regulated lake level issue dealt with primary production in Voyageurs' four large lakes and the relationship between lake levels

*1m = 39.37 in.

and boat docks. Results of studies conducted by other researchers, while not specifically a part of this program, were used to assess the impact of the regulated lake levels on the park's archeological resources.

Next, researchers developed a hydrological model to assess effects of alternative regulatory programs (Flug 1986). The model simulated the multi-lake system beginning with inflows of Namakan Reservoir and ending with outflows from Lake of the Woods. In order to restrict the modeling effects to this portion of the basin, outflows from Lake of the Woods were given the highest priority and were forced to match actual historic releases.

This approach was used because it would allow the NPS to present meaningful recommendations to the IJC for alternative regulatory programs if the research results showed that the current water management program was having adverse impacts on the aquatic biota. It would also allow testing whether alternative programs that more closely approximate natural conditions could be used to reduce adverse effects on the aquatic biota without seriously conflicting with the other authorized water uses (Cole 1982). Should the IJC authorize an alternative program, this information would serve as baseline information which could be used to evaluate the impacts of the new regulatory system on authorized water uses.

Environmental Consequences

The species and biological communities investigated in Voyageurs generally were found to be adversely affected by the present water management programs. They were especially impacted by the greater than natural water level fluctuations on the Namakan Reservoir lakes. These plants and animals have been unable to adjust to the changes in the magnitude and timing of lake level fluctuations since the dams were constructed, and in particular to the water management program used since 1971.

Negative impacts on Voyageurs' aquatic ecosystem occurred throughout the year. Those that took place in

Continued on page 4

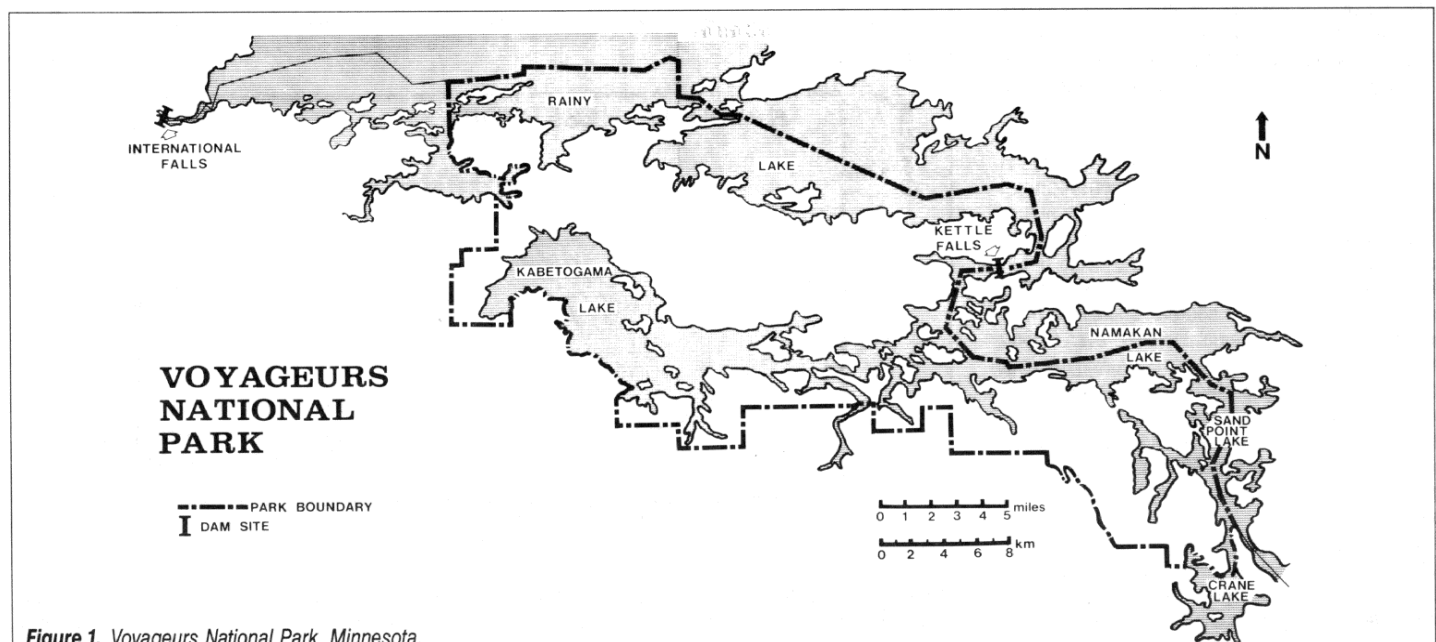


Figure 1. Voyageurs National Park, Minnesota.

Voyageurs NP Lake Levels

(Continued from page 3)

a particular season frequently were the result of a combination of water level conditions that occurred in previous seasons. For example, high stable summer and early fall water levels contribute to spring spawning problems for northern pike and walleye by causing potential vegetative and wave washed gravel spawning substrates to develop at relatively high elevations. This, in combination with a large winter drawdown, makes the flooding of these preferred substrates the following spring difficult, particularly in low runoff years. Thus, while poor spawning conditions are usually blamed on low spring water levels, they are actually the culmination of a series of water management actions that occurred throughout the year.

Similar interactions were observed for the other organisms studied. The large winter drawdown on Namakan Reservoir and the resultant low spring water levels make large water level changes necessary in May and June to meet navigational needs. These changes were found to adversely affect aquatic bird nesting success and establishment of wild rice stands. During the period from 1983 to 1985, 47 percent of the loon nests on Namakan Reservoir were lost to flooding while on Rainy Lake, with its less than natural fluctuations, 27 percent were lost. Red-necked grebes were even more sensitive to lake level changes. From 1983 to 1985, 77 percent of the grebe nests on Namakan Reservoir were lost to flooding; on Rainy Lake 45 percent were lost.

High stable summer water levels, extremely favorable for navigation, appeared to limit the establishment of wild rice and other aquatic vegetation. They also caused beaver and muskrat to build their lodges and food caches at elevations that left them extremely susceptible to the larger than natural winter drawdown Namakan Reservoir experiences annually. The winter drawdown, which causes up to 25 percent of the Namakan Reservoir area to be dewatered annually, forced nearly 80 percent of the beaver to abandon their lodges and food caches. These beaver spent most of the winter in wood-chip nests under the ice outside their lodge and were forced to find other food. As a result, they lost more weight, had fewer offspring, and were more susceptible to predation than beaver from more stable, inland ponds.

The large winter drawdown also forced otter to alter their home ranges and limited the diversity and abundance of benthic organisms, an important food source for fish. Similar effects were noted for aquatic vegetation.

The present water management program was found to adversely impact the park's archeological resources. Approximately 75 percent of the archeological sites were partially or totally destroyed by the rise in lake levels resulting from the building of the dams. Of the sites that remain, only those located behind and protected by bedrock shorelines have escaped damage. The remaining sites, even though they are located above the present maximum lake levels, continue to be impacted by the undercutting and bank slumping that results from intense wave action during the period when lake levels are at their summer peaks. An archeological site stabilization program was initiated in 1985 but to date only three sites have been completed.

It is felt that most of these biological and archeological problems could be overcome by implementation of a water management program that more closely approximates the magnitude and timing of natural fluctuations in lake levels with which the affected species

Table 1. Names and affiliations of researchers involved with regulated lake level studies in Voyageurs National Park, 1983-1987. (P.I.) = Principal Investigator.

Hydrology

Dr. Marshall Flug NPS, Water Resources Division

Primary Production

Dr. Robert Stottlemeyer (P.I.) NPS, Great Lakes Area Resource Studies Unit
Ray Kepner Michigan Technological University

Fisheries

Larry Kallemeyn NPS, Voyageurs National Park

Beaver-Muskrat-Otter

Dr. Rolf Peterson (P.I.) Michigan Technological University
Douglas Smith (beaver) Michigan Technological University
Joanne Thurber (muskrat) Michigan Technological University
William Route (otter) Michigan Technological University

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Dr. Francesca Cuthbert (P.I.) University of Minnesota, St. Paul
Arlene Rothstein University of Minnesota, Duluth

Aquatic Vegetation

Dr. Paul Monson University of Minnesota, Duluth
Dr. Douglas Wilcox NPS, Indiana Dunes National Lakeshore
James Meeker University of Wisconsin

Benthos

Dr. Kenneth Kraft Michigan Technological University

Boat Docks

Larry Kallemeyn NPS, Voyageurs National Park

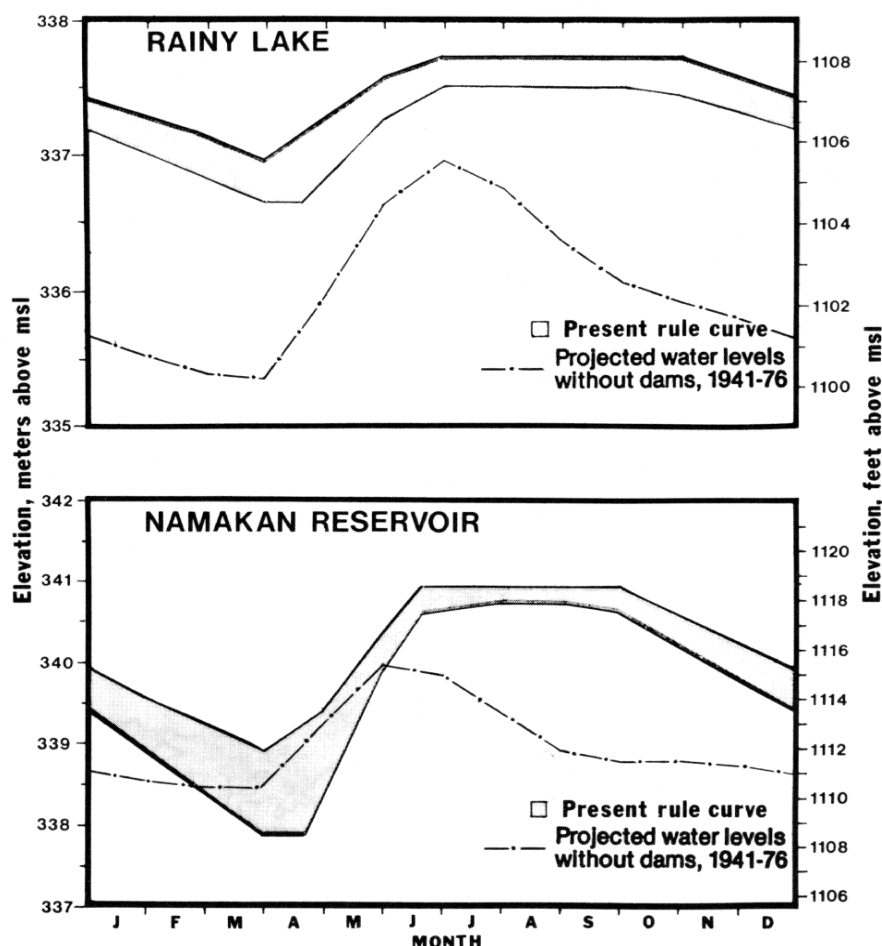


Figure 2. Present water management programs (Rule Curves) and computed natural lake levels for Rainy Lake and Namakan Reservoir, Minnesota and Ontario, Canada. Elevations given in meters and feet above mean sea level (msl).

Voyageurs NP Lake Levels (Continued from page 4)

evolved. Obviously, complete restoration of natural conditions in the park is not possible due to the presence of the dams and the requirements of other water users. However, development of an alternative water regulatory program that is more ecologically sound appears possible given our understanding of the relationship between water levels and various biological factors.

Alternative Regulatory Programs Assessment

Using the research study results as well as input from other water users, 15 alternative regulatory programs were developed. Each alternative was analyzed with the hydrology model to see if the reservoir system could accommodate the modified program under normal hydrologic conditions as well as extreme high and low water conditions. The model also provided projections of hydropower production for each alternative.

To tie the results of the environmental studies and the hydrology model to potential impacts from the various alternative regulatory programs, an impact assessment matrix was developed. The study results and information from the scientific literature were used to develop ranking factors for 22 resource attributes, including in addition to the various biological factors, hydropower production, navigation, flood control, and boat dock usability and susceptibility to ice damage. These ranking factors were then used to evaluate the effect of each alternative regulatory program on the various attributes, with the results entered into the matrix. The matrix, although based on simplifying assumptions about complex ecological and economic relationships, provided a means of integrating the information so that it could be used to facilitate discussions among the various water users.

The matrix is now being used by NPS and a coalition of citizen groups, resort and other commercial interests, and fishermen to develop a consensus for an alternative that they can recommend to the IJC – one that will meet all their needs and still restore more natural hydrological conditions to this reservoir system.

An example of this selection process is this comparison of the alternative regulatory programs, L8 and BLC-88 (Fig. 3). If the only consideration were restoration and conservation of Voyageurs' natural environment, alternative L8 would be preferred, since it approximates natural hydrologic conditions and consequently receives high rankings for most of the biological attributes. Because of its summer drawdown, however, it would receive low rankings in regard to navigation and dock usability in late August and September. BLC-88 with its reduced summer drawdown is an attempt to improve conditions for those attributes while still providing favorable conditions for the various biological attributes. Other conditions under the two alternatives would be similar.

Obviously, compromises such as this will be necessary to meet the legally recognized needs of the other water users and will preclude the complete restoration of natural conditions in the park. Implementation of any alternative will need to be accompanied by research and monitoring programs designed to document the actual effects of the modifications on the different interests. This will allow testing whether an alternative program can reduce the adverse effects on Voyageurs' aquatic ecosystem without seriously conflicting with other water uses. Based on such research and monitoring results, the alternative program could, if necessary, be further adjusted to achieve desired results for all.

Kallemeyer is Aquatic Research Biologist at Voyageurs NP.

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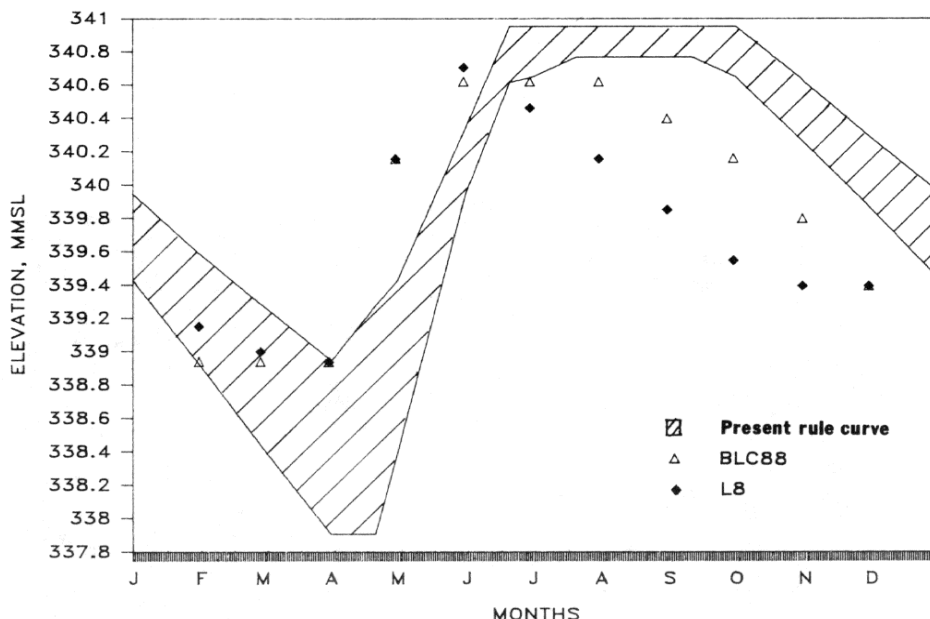


Figure 3. Comparison of the present water management program (Rule Curve) and alternative regulatory programs, L8 and BLC88.

SER Offers Restoration Program for St. John

The recently founded Society for Ecological Restoration has jumped right into the business of public involvement in restoration efforts and the raising of public awareness. The primary target is St. John in the Virgin Islands. The nature of this initial project and the manner in which it came about both illustrate the enormous vitality of the "networking" that is binding the conservation community into a global entity.

SER News, the Society's quarterly newsletter, describes the "remarkable set of coincidences" that led to this pilot project. An entrepreneur, Stanley Selengut, who operates a St. John resort that is widely recognized for its environmental sensitivity, read about SER's 1989 Oakland conference in the March issue of *Smithsonian* magazine. He saw the Society's proposed "Excursion" program for public participation in restoration work as a valuable way of reconciling conservation and development interests.

SER, in turn, recognized St. John as "virtually a restoration project waiting to be undertaken," saw the fine work that had been done already by the National Park staff there, and recognized the opportunities for tackling the unfinished restoration business of the island (tropical dry forests and coral reefs being two of the most endangered ecosystems on earth.)

On top of the public relations value of tying in with the Columbus quinqucentennial, SER board members liked the tie-in with the national park, which, as part of a Biosphere Reserve system, has a standing commitment to both restoration and the harmonizing of human activities with conservation considerations.

The SER Excursion program is modeled after the highly successful Earthwatch program, except that it will specialize in the actual work of restoration and associated education programs rather than research. Information may be had from Bill Jordan, editor of the *SER News* and of *Restoration & Management Notes*, 1207 Seminole Hwy, Madison, WI 53711; (608) 262-9547.

The Bergen Conference: Action For a Common Future

In April 1988, the member governments of the Economic Community for Europe (ECE) welcomed the initiative of the government of Norway to organize a Regional Conference for Europe and North America in cooperation with ECE and in consultation with the United Nations Environmental Programme (UNEP), involving labor, industry, youth, the scientific community, and other nongovernmental and intergovernmental organizations.

The result was "The Bergen Conference: Action for a Common Future," to be held in Bergen, Norway, May 8-16, 1990.

Associated with this conference will be an international meeting of scientists, an international youth conference, and a trade and technology fair featuring environmentally sound technology, concerts, exhibitions, and other events that together will form "a free-ranging environmental festival."

See Calendar for contact.

Gateway Pond: Ecosystem Revitalization

By John Tanacredi

Fires at Yellowstone would appear to have very little to do with the creation of a pond as an example of ecosystem revitalization. However, not unlike the restorative function and increase in biodiversity that fires bring to large ecosystems such as Yellowstone, a relatively small fire at Gateway National Recreation Area, in the heart of the urban milieu, was responsible for a series of small decisions leading to the creation of an aquatic habitat on a reclaimed-to-nature portion of an abandoned military air field.

It all started in early April, 1983. The "North 40" of Floyd Bennett Field, so entitled due to its isolation from visitors use, had a fire encompassing about 40 acres. *Phragmites*, the predominant plant that burned, left bare the old and inhospitable landfilled surface of Floyd Bennett Field. Within two days of the fire a torrential downpour occurred, filling the fill depressions with water.

With summer heat lingering that year, the air temperature had contributed to a dramatic increase in the number of many resident bird species using the area. The "ponds" attracted even more waterfowl, so the thought occurred, "why not make permanent ponds there?"

From April to September the site was surveyed and photo-documented. Tests were made to determine soil consistency and whether any contaminants were there. The projected equipment, funding, staffing and maintenance needs were prepared. Sources of freshwater were noted. All abandoned electric, water, sewer lines were plotted so that none were within the boundaries of potential pond excavation. A trail was created on paper and signage was suggested.

All of this was documented, reviewed and approved in-house by late September, 1983. Then Fiscal Year 1984 Gramm-Rudman or its equivalent struck! No funding was available for implementation; cuts in staffing meant no long-term maintenance.

At a meeting in early 1984 with representatives from the New York State Department of Environmental Conservation (NYSDEC), I learned that projects could be funded under the New York State "Return-A-Gift to Wildlife" program. Taxpayers make a check in the right column of their New York State Income Tax Returns and a percentage of those returns is returned to NYSDEC for the preservation, protection and enhancement of wildlife through a variety of competitively sought project proposals. It appeared somewhat incongruous for a Federal Government entity to seek a

"State Grant" to conduct a habitat restoration project. However, there was no stipulation excluding the National Park Service from seeking funding as long as we maintained the project long-term, and provided some in-kind costs (i.e. staff time, signs, publicity, and security to the site activity), so we took the plunge.

On May 16, 1986, NYSDEC announced the transfer of \$20,000 through the Return-A-Gift Program to a special NYSDEC account to be utilized for the establishment of an urban wildlife management area in New York City. The approved proposal was the National Park Service-Gateway Floyd Bennett Field "North 40 Pond!"

The selection criteria noted is classic since both the mandates of our respective agencies were meshed in the right gears ... we could truly make progress toward increasing potential habitat for wildlife with commensurate increases in biodiversity in urban stressed ecosystems; the site had an active constituency using the Field for interpretative/education program through NPS cooperative agreements with the New York City Board of Education, New York City Chapter Audubon Society, Cornell Cooperative Extension and New York State Department of Recreation and Historic Preservation; the site was certainly accessible to the visitors of Gateway National Recreation Area; the site was one where a long-term commitment by the agency is provided for its maintenance and upkeep; and there would be only a one-time cost by NYSDEC to establish the area.

All the criteria were met. We were on our way! We even had a dedication date planned; September 1986!

In July 1986, we prepared a Site Development Plan which built on the Park's General Management Plan and Floyd Bennett Field DCP; both discuss "environmental zones" for research and education and wildlife preservation on the field. This Action Plan for the "North 40" called for the establishment of designated trails, closing off other roadways or trails to random vehicle or human access, initiating interpretive programs, and a number of wildlife enhancement demonstration projects.

Creation of the approximately one-acre freshwater pond was central to the plan. Proximity of the pond to the waters of Jamaica Bay would encourage birds seeking fresh water to use this pond. After excavation, revegetation of spoil berms around the pond would involve use of plants with wildlife support-capability, either for food or wind erosion control.

In the pond itself an assortment of freshwater spe-

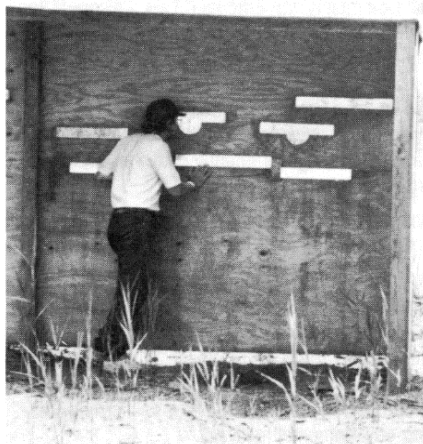
cies ranging from deep-water submergents to shallow water emergents would be planted. Sago pondweed (*Potamogeton pectinatus*), Arrowhead (*Sagittaria latifolia*), and Smartweed (*Polygonum pennsylvanicum*) to name a few. One of the berms ground cover such as Wild Millet (*Schinochloa crusgalli*) and Birdsfoot Trefoil (*Lotus corniculatus*) will be utilized among others, to be established through cuttings and seeds started in the Park's Greenhouse/Nursery stock area. Nest boxes, native animal releases, and plantings to attract insects were all part of the "North 40 Pond Management Plan." The next step was to establish a Memorandum of Understanding between NYSDEC and the NPS. This was completed and officially signed by both parties in February 1988. NYSDEC began the solicitation of contractors to bid on the pond excavation and finally on March 16, 1989, a bulldozer began the excavation. It took only two weeks to complete the pond. By September 1989 the pond had bird-blinds, completed by the New York City Telephone Pioneers, a volunteer group of retired New York Telephone Company employees with extraordinary talents in carpentry and natural resource management support construction. The trail (over 1.5 miles) had been cut by NPS maintenance crews. The berm plants were established through joint efforts by an NPS agronomist, Cornell University, New York City Board of Education, New York City Chapter Audubon, and NPS Jamaica Bay District interpreters and the trail signs had been purchased.

On August 31, 1989, an official ribbon cutting took place. From inception to ribbon cutting the project took six years and five months!

We are now monitoring the reptiles, amphibians, plants and water of the pond, and the many organisms we have introduced. Barn owl boxes will be placed and the designated parking areas on the Floyd Bennett Field Runway will be established.

Progress is measured many times in levels of persistence, perseverance, and sheer desire. The way the venture unfolded created a multiplier effect. We captured an extra energy, enthusiasm, and extended participation that is enriching the overall impact of Gateway NRA on the urban community of which it is a part.

Tanacredi is a research ecologist and Chief of Gateway NRA's Office of Resource Management and Compliance.



Through the peephole in the observation blind, built by telephone company volunteers, the lake looks like this (right) and wildlife is undisturbed.

Landscape Ecology – A Concept for Protecting Park Resources

By Craig Allen, John Lissoway
and Keith Yarborough

The Southwest Region has been supporting Resource Basic Inventory (RBI) efforts to establish baseline data for comparisons with long-term monitoring results to be conducted in the future. This "pulse taking" is a part of the Servicewide initiative being fostered so that resource managers, scientists, and park managers will be able to track the health of park resources by determining changes and trends. The RBI work is being linked with the development of Geographic Information Systems (GIS) at Bandelier, Big Thicket, Big Bend, Padre Island, and Guadalupe Mountains. Many of the parks in the Southwest Region have only partially completed RBIs. This informational shortcoming is a pervasive threat to the parks because without detailed knowledge of the parks' respective resources the Service cannot protect them adequately.

To overcome this deficiency, the SWRO's Division of Natural Resources Management and Science has fostered at Bandelier a pilot research effort, which started in FY '87 and utilizes a **landscape ecology paradigm**. This concept links the RBI, GIS, and research activities in a park to present an overall picture of the park in its regional ecosystem setting. The flowchart diagrams this project's concept. The results have been encouraging. A final report was recently completed (Allen 1989). This concept may now be applied to other Southwest Region parks.

What is the Landscape Ecology Paradigm Used in this Study?

1. Spatial scales are important. Landscape ecology is based upon a spatial hierarchy of ecosystems (Urban et al 1987). A *landscape* is an area at least several kms wide where a recurring pattern of relatively homogeneous ecosystems (patches) is identifiable (Forman and Godron 1986). *Landscape ecology* is concerned with the spatial distribution and interactions between ecosystem patches at the landscape level.

2. Temporal scales also are important, as landscapes change through time. Since landscapes are dynamic, landscape ecology considers changes in landscape structure and function through time (Delcourt and Delcourt 1988).

3. Disturbance regimes of various sorts are recognized to be ubiquitous and important processes that drive the interactive dynamics of landscapes and their component patches (Pickett and White 1985).

4. Landscape ecology strives for integrative, interdisciplinary, and holistic perspectives and approaches to research and management issues (Risser 1985).

5. Landscape ecology shares the perspective that has developed in the emerging field of *conservation biology* that all reserves are islands set within and linked to larger landscapes (cf. Soulé 1986). Parks are thus subject to a variety of problems related to habitat fragmentation and isolation from the surrounding landscape. Further, as reserves become increasingly insularized they are found to be threatened with disruption from numerous external sources. Boundary considerations are important (Schonewald-Cox 1988). Effective management of the local ecosystems of parks requires attention to the landscape context in which they are embedded (Agee and Johnson 1988).

This pilot research project was set in the Jemez Mountains of north-central New Mexico, which rise as a large, island-like, volcanic landmass at the southern edge of the Rocky Mountains. Relatively homogeneous local ecosystems can be distinguished within the Jemez Mountains based on site-specific vegeta-

tion, landforms, and soils. These local ecosystems range from open shrublands of juniper (*Juniperus*), saltbrush (*Artriplex*), sagebrush (*Artemesia*), and rabbitbrush (*Chrysothamnus*) in Aridic Ustochrept soils on the alluvial floodplain of the Rio Grande at 1550 m in elevation, to spruce-fir forests (*Picea engelmanni*, *Abies lasiocarpa* var. *arizonica*) in Typic Cryoboralf soils on the highest, north-facing, mountain slopes at 3500 m.

When spatially aggregated, the local ecosystems of the Jemez Mountains form a repeated mosaic pattern that may be considered to compose a single landscape. Bandelier NM comprises a complete altitudinal transect in the southeast flank of the Jemez Mountains, including examples of most of the ecosystems present in this landscape. Yet Bandelier (13,300 ha) is only a small fragment of the overall Jemez Mountains landscape (543,500 ha) in which it is set.

Past ecological work in the Jemez Mountains has focused on the level below local ecosystems, on studies of ecosystem parts; there has been a conspicuous absence of landscape-level work. Resource management and land-use planning activities in the Jemez Mountains have been hampered by this lack of landscape-level ecological information.

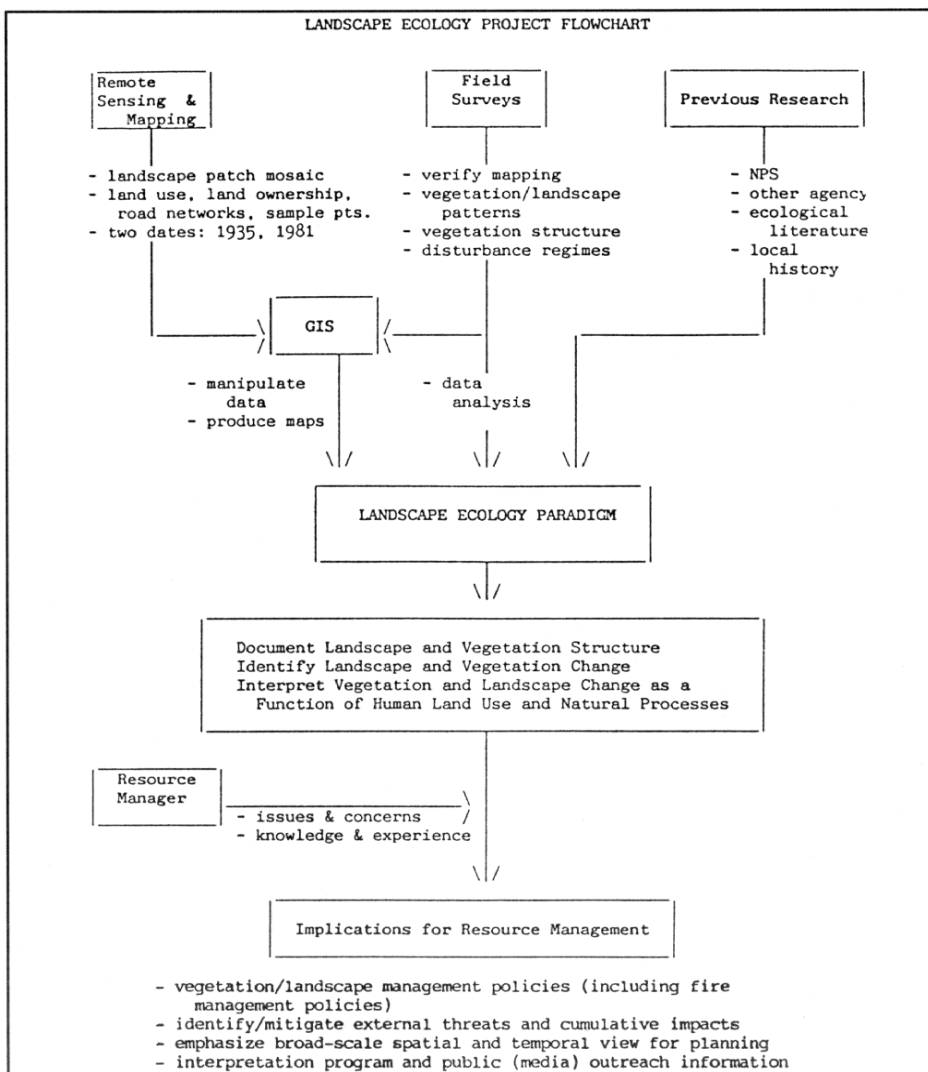
The Jemez Mountains are subject to an increasing variety and intensity of stresses from human activities,

with uncertain cumulative impacts on individual species, ecosystems, and the landscape as a whole. Especially worrisome are impacts from logging, grazing, mining, recreational activities, air and noise and water pollution, fire suppression, highways, reservoirs, powerline corridors, and human settlements. External impacts to park resources represent a major set of management issues for Bandelier. In the absence of a landscape vision of the Jemez Mountains many opportunities to mold a desirable landscape by conscious choice and awareness of tradeoffs have been lost to piecemeal "development."

In summary, this project developed a landscape-level framework for describing the structure of the Jemez Mountains landscape in which the ecosystems of Bandelier NM are embedded. This design allowed landscape-level changes to be noted and their implications assessed, thereby helping the NPS meet its goals for effective, long-term management of "our" ecosystems. An integrative landscape ecology framework also provided a context to organize and improve the management usefulness of past ecological studies. The methodology developed here is applicable to other NPS units.

Allen conducted this research while a doctoral student U/Cal, Berkeley; he is now an ecologist with

Continued on next page



Pacific Northwest

The Interior Department's Minerals Management Service (MMS) has funded several studies to investigate long-term effects of oil spilled from the barge Nestucca on the coast of Washington. About 6000 barrels of bunker C crude spilled when the barge was damaged by its tug offshore Grays Harbor, WA in late December 1988. Beaches were oiled from Grays Harbor to Vancouver Island, Canada, including Olympic NP. Most obvious effect to wildlife was the loss of an estimated 9000 seabirds.

Three of the MMS projects are being funded through a cooperative agreement with the US Department of Energy and in cooperation with NPS. Study participants include two research teams from UWA and Batelle Pacific NW Labs. Twelve study sites include representative sites from the primary beach types in the area, both oiled and unoiled. The beach types included are sandy, cobble, and rocky beaches. Sites chosen in Olympic NP are sites for which pre-spill data have been collected.

John Aho, Olympic NP wildlife biologist, is park staff coordinator and will respond to inquiries from *Park Science* readers.

Doug Houston, PNR research biologist stationed at Olympic NP, is the NPS representative, serving as technical advisor, to a spotted owl research committee funded through USFS. The committee held its first meeting in late November, with field trips throughout spotted owl habitat in Oregon. Houston reports that a committee-produced plan for spotted owl conservation is scheduled for readiness by March 1990.

Ed Starkey, wildlife ecologist with the Oregon State University NPS/CPSU was in Washington, DC Dec. 5-6 for meetings to identify what is known about bru-

Cole Memorial Publication

"Fate of Coho Salmon (*Oncorhynchus kisutch*) Carcasses in Spawning Stream," dedicated to the memory of one of its authors, Don Cole, who died before the study was completed, appeared in *Canadian Journal of Fisheries and Aquatic Sciences*, Vol. 46, 1989, pp. 1347-1355. Co-authored by Doug Houston, W.J. Scarlett, and C.J. Cederholm, the study found that much of the fish mass from the 945 coho salmon released experimentally into 7 spawning streams on the Olympic Peninsula was consumed by 22 species of mammals and birds, that the capacity of many streams and rivers to retain carcasses probably had been reduced by human activities, and that the importance of coho carcasses to populations of carnivores and to the dynamics of lotic (flowing water) food webs merit additional study.

Reprints are available from Houston at Olympic NP.

cellosis in the Greater Yellowstone area, recommend any additional research needed, and identify management alternatives. The meetings are being held under the joint aegis of NPS and the Animal and Plant Health Inspection Service (APHIS).

Dave Peterson was selected in November to fill the research biologist position at the NPS/CPSU, UWA. His research background and interests include the effects of air pollutants on forest resources, effects of global atmosphere change on forests, and fire ecology.

Gerry Wright, NPS biologist with the U/ID CPSU, is spending 6 to 8 weeks assisting Gettysburg National Military Park with preparation of an EIS for managing deer damage to the park's cultural landscape.

Copies of the Pacific Northwest Region's *Annual Science Report - 1988* are now available from PNW Region headquarters in Seattle, WA.

"I had \$1.5 million, 25 biologists, and 9 birds - plus about 20 conservation groups who wanted to tell me how to run the California Condor recovery program."

Michael Scott, leader of the Idaho Cooperative Fish and Wildlife Research Unit at U/ID, was addressing the bi-annual meeting of the NPR science group Nov. 29-30 in Moscow, ID.

In addition to a sometimes-grim, sometimes hilarious account of his struggle to maintain those "magnificent flying garbage cans" as a viable population in the wild, Scott described something called "Gap Analysis of Species Richness and Vegetation Cover: An Integrated Conservation Strategy for the Preservation of Biological Diversity." He has promised a future article on the subject for *Park Science* readers.

Alaska Region

Dale Taylor, wildlife research biologist with the ARO, and Paul Haertel, Assoc. Reg. Dir. for Resources, were on the team of American and Soviet specialists who visited the Chukotskiy Peninsula in the USSR, the Seward Peninsula, and other regions in Alaska to investigate the feasibility of an international park. People in both countries expressed "overwhelming" support for the concept.

The team was part of Working Group 02.04-20 "Conservation and Management of Natural and Cul-

tural Heritage" under the Joint Soviet-American Agreement on Cooperation in the Field of Environmental Protection. The team was led by Denis Galvin, WASO, Chief of Planning, and included Rich Giamberdine, Denver Service Center. Superintendents and staffs at Bering Land Bridge, Northwest Areas, Gates of the Arctic, and Denali were integral parts of the visit on the American side.

Dr. Yuri Chernov, leader of the Soviet arctic MAB project, and Dr. Nada Matveyeva were escorted to Noatak National Preserve and Biosphere Reserve by Taylor and Kate Roney, NW Alaska Areas resource management specialist. The Soviet visit is a continuing step in pairing Noatak with a Biosphere Reserve in the USSR.

Al Lovaas spoke on "Monitoring for Global Change - A National Park Service Perspective" at the September Arctic Science Conference on Global Change in Fairbanks. Al and Ted Birkedal participated in a conference workshop, "Long-term Data Sets Assessing Regional or Global Change." Dale Taylor, originally scheduled to give the natural resource presentations, was "exiled to Siberia" at the time.

Sara Wesser, biologist and most recent addition to the ARO Natural Resource Division staff, recently completed requirements for the M.S. degree at U/AK Fairbanks. Her thesis, "Controls Over Species Distribution across a Forest-Steppe Transition in Interior Alaska: A Correlative Model and Experimental Tests," applies directly to species present at Yukon-Charley Rivers National Preserve.

Taylor and Lee Anne Ayres, biologist with NWAA, presented posters at the American Society of Mammology meeting in Fairbanks. Taylor's poster was on monitoring road traffic impacts on wildlife in Denali NP; Ayres' poster dealt with inventory of small mammals in Noatak River Basin, NW Alaska.

Regional Wildlife Biologist Layne Adams presented a poster on "Comparisons of Bear and Wolf Predation on Caribou Calves, Denali NP and Preserve, and co-authored with Alaska Dept. of Fish and Game biologists a paper titled "Influences of Body Weight on Early Puberty, Pregnancy, and Reproductive Histories in Alaskan Caribou" at an international workshop in St. Johns, Newfoundland.

Mid-Atlantic Region

From Jeff Marion, recently transplanted to the new CPSU at Virginia Tech, comes word of an organization known as the Multi-State Fish and Wildlife Information Systems Project (MSFWIP), which operates a computerized database through staff sponsored by cooperating states - typically in Natural Resource departments. Their national office is in Blacksburg, VA, and is closely associated with the VA Dept. of Fisheries and Wildlife.

According to Marion, MSFWIP has developed "a very impressive database, using Advanced Revelations - a package similar to dBASE - which operates on microcomputers. Cooperating states must sponsor the data collection and input, but if an adjacent state already has put in a lot of information, the data is shared and only revised. Data collected is on all animal species, not just RT&E. For more information contact MSFWIP at 102 Colony Park, 2001 S. Main St., Blacksburg, VA 24060. 230/231-7348.

Landscape Ecology

(Continued from page 7)

Bandelier. Lissoway is the Chief of Resource Management at Bandelier; Yarborough is a physical scientist with the Division of Natural Resources and Science, SWRO.

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Florida Panthers Found With High Mercury Levels

Biologists from the Florida Panther Interagency Committee are currently evaluating the significance of high levels of mercury found in the livers of Florida panthers.

After finding a mercury level of 110 parts per million (ppm) in the liver of a dead panther, the U.S. Fish and Wildlife Service (USFWS) conducted additional tests on various tissues of other dead panthers. Test results from the livers of 11 dead panthers ranged from .049 to 20 ppm.

The Florida Game and Fresh Water Fish Commission also conducted tissue sample tests and is awaiting results. The agencies conducted 33 tests on various tissues, including hair samples, from live panthers. Panthers from various locations across their south Florida range were tested.

The Florida Panther Interagency Committee is composed of the USFWS, NPS, the Florida Game and Fresh Water Fish Commission, and the Department of Natural Resources. Significance of high mercury levels in panthers and how it will affect their chances for survival are among issues being reviewed.

"Now that we know the mercury problem in Florida affects the panther, we can work together to analyze the situation and decide what to do," said John Christian of USFWS. "These data represent the first evidence of mercury working its way high up in the south Florida food chain and put additional emphasis on the importance of finding the source of the contamination and taking corrective action."

Mercury concentrations of 0.5 ppm or higher in fish have prompted health officials to urge people to limit or discontinue consumption of fish from affected waters throughout Florida. Mercury contamination also prompted the Commission to cancel authorized alligator hunting in certain areas of south Florida in September.

It was the female panther known to scientists as Number 27 that carried the mercury level of 110 ppm. She was found dead in Everglades NP in July. At the time, scientists could not determine the cause of death. They now think she may have died of mercury poisoning.

"We know for a fact that Number 27 fed primarily on raccoons," said Oron L. "Sonny" Bass, research biologist with Everglades NP. "Since raccoons are mainly fish-eaters, we suspected this panther accumulated a lethal amount of mercury through the aquatic food chain."

Southeast Region

Bruce Rodgers has moved to SERO as a Resource Management Specialist. He goes to Atlanta from 2 years as site manager of Fort Jefferson National Monument. Prior to that, he spent 7 years as a resource management specialist at Assateague Island NS. Rodgers has a B.S. in biology and has done graduate work in zoology and resource management. His work in SERO will include wildlife management and endangered species issues.

Copies of the Southeast Region's *Annual Science Report - 1988* are now available from the Science and Natural Resources Division, SERO, 75 Spring St. S.W., Atlanta, GA 30303.

Fort Jefferson National Monument received an unwelcome visitor around 3 a.m. on Oct. 30, 1989. A 475-foot Yugoslavian freighter ran aground on a coral reef in the northeast corner of the 65,000-acre monument. The freighter was fully loaded with fuel, and carried a cargo of triple phosphate fertilizer. Personnel from Fort Jefferson assisted the U.S. Coast Guard in placing containment booms around the grounded vessel, and a team made up of NPS and Florida Department of Natural Resources divers conducted a detailed assessment of damage to the coral reef. The assessment revealed that about 10,000 square meters of the living coral reef had been destroyed or severely damaged as the ship ran aground.

After a two-day fuel offloading procedure, the ship was pulled from the reef undamaged, with no spillage of cargo or fuel.

The fragile reefs of the Florida Keys have been undergoing a sudden series of assaults from errant vessels. Four days prior to the Fort Jefferson grounding, another freighter ran aground within the Key Largo National Marine Sanctuary. One week after the Fort Jefferson incident, yet another freighter struck the reef near Key Largo. Each of these groundings resulted in significant damage to the living coral.

Stephen Nodvin of the NPS CPSU at U/TN, and U/TN graduate student Carolyn Reeves attended a September meeting on Resource Management Implications of Global Climate Change and Forests in Transition, in Boulder, CO. The meeting was sponsored by the USFS and the National Center for Atmospheric Research (NCAR). Nodvin and Reeves were invited to attend by Dr. Stephen Schneider, a NCAR meteorologist who developed one of the General Circulation Models being used to project future trends in climate.

Presentations were given on climate history and old-growth trees, long-term data management, hydrological disturbances, ecological implications of fire and pest disturbances, atmospheric chemistry, and land use and forest management. Participants included scientists from NCAR, USFS, NPS, The Nature Conservancy, Canadian Forest Service, USGS, NOAA, Goddard Institute for Space Studies, Audubon Magazine, and a number of universities, including Freiburg (West Germany), Arizona, Colorado, Yale, Auburn, Virginia, and U/Cal Berkeley. Nodvin presented work he and Reeves are initiating on the implications of climate change in the southeast region.

The Sixth Annual Gatlinburg Acid Rain Conference was held on Oct. 30-31, 1989, in Gatlinburg, TN near Great Smoky Mountains NP (GRSM). Sponsored by the TVA, the conference focused on effects of acid rain on forests and aquatic systems and implications of a changing climate. Presentations of particular interest included the spruce-fir ecosystem in the Smokies and along the Blue Ridge Parkway by Niki Nicholas, Virginia Polytechnic Institute and State University, and Ernest Bondietti and Samuel McLaughlin, Oak Ridge

National Laboratory (ORNL); the effects of acid deposition on the streams, lakes and reservoirs of the Southern Blue Ridge by Jerry Ellwood, ORNL; and the results of soil-solution studies at the Integrated Forested Studies sites near Clingman's Dome, GRSM, by Helga Van Miegroet, ORNL. A special session on climate interactions was chaired by Stephen Nodvin of the U/TN CPSU. Included in the session were presentations by TVA's Barbara Miller on climate change and water resources, by Nodvin and Reeves on climate change and national parks in the southeast, by Elizabeth Groton (TVA) on tree growth and climate relationships, by Virginia Dale and Mac Post (ORNL) and John Pastor (U/MN) on forest nutrient cycling and climate change, and by Virginia Dale (ORNL) on climate changes and forests in western Oregon. Robin Graham (ORNL) keynoted the conference with her presentation on the greenhouse effect. The Southern Appalachian Man and the Biosphere Cooperative (of which NPS is a supporting agency) and TVA will co-sponsor the 1990 Gatlinburg Conference.

Southwest Region

The CPSU at U/AZ hosted a GIS Desert Parks Workshop in Tucson in August. Mike Kunzmann and Roy Johnson organized the workshop with WASO funding and 70 NPS managers, researchers, resource managers, and interpreters attended - mostly from the Western Region but some from as far away as Canada. Also in attendance were representatives from federal, state, and local government and the private sector.

Instructors came from NPS, USFS, and from independent hardware and software companies. GIS Steering Committee meetings were chaired by Kunzmann and featured Harvey Fleet of GIS, Denver; George Turnbull, WRO; Roy Johnson, CPSU, U/AZ; Gary Davis, CHIS; and Phil Guertin, U/AZ.

A Desert Parks Workshop was held in October in Tucson, hosted by the U/AZ CPSU and Saguaro National Monument. The workshop was the outgrowth of a proposed Desert Parks initiative by Death Valley Supt. Ed Rothfuss and others.

Attendees were divided into four working groups: socio-economic, resource management, cultural resources, and maintenance and design. Presentations covered management problems and other subjects unique to desert areas, all within the framework of the work group designations. The work groups produced recommendations regarding the issues brought up at the workshop and presented them to the Associate Regional Directors.

The following two technical reports from the CPSU at U/AZ may be had from Denny Fenn, CPSU leader: Bennett, Peter S. and Michael R. Kunzmann. 1989. *A History of the Quitobaquito Resource Management Area, Organ Pipe Cactus National Monument, Arizona*. Technical Report No. 26. CPSU, University of Arizona, Tucson, AZ. 88 pp.

Swetnam, Thomas W., Christopher H. Baisan, Peter M. Brown, and Anthony C. Caprio. 1989. *Fire History of Rhyolite Canyon, Chiricahua National Monument*. Technical Report No. 32. (same as above); 47 pp.

Despite unseasonably warm weather, five peregrine falcon chicks appear to be doing fine in the Chisos Basin area of Big Bend NP. The high temperatures may

Southwest Region (continued)

have reduced the 1989 peregrine reproduction, so these hatchlings are especially welcome.

Also at Big Bend, a long-term geohydrologic study conducted by the USGS Texas District Office under contract from the NPS Water Resources Division is nearing completion. The final phase involves drilling of test wells to determine the recharge area and aquifer characteristics for Oak Springs, a major water source in the park, both for wildlife and for visitor use. Earlier research has shown no subsurface link between the developments in the Chisos Basin and Oak Springs, alleviating concerns that contamination from human activities might be impacting the springs' water quality.

Another water quality issue which threatened Ratlesnake Springs, the main source for Carlsbad Caverns NP, has been resolved by a geohydrologic study by Dr. Mark Richard of U/CO. The springs were threatened by a pollution plume emanating from nearby natural gas injection wells and an underground liquified gas storage reservoir. The study showed that repairs of the leaks in the injection wells' casings stopped the problem and the springs have not been impacted. A monitoring program is being established as well as interactions with El Paso Natural Gas Co., which manages the facilities.

Milford Fletcher, Regional Chief Scientist, and Deb Pfenninger, natural resources specialist at Hot Springs, have completed an extensive bat counting study. This work has produced the necessary software to link with off-the-shelf, adapted hardware for obtaining the first really accurate count of bats as they emerge from their daytime roosts to begin their nightly food foraging. Test applications have been made at Jornada Bat Cave and at Carlsbad Caverns, both in New Mexico.

A number of resource management specialists are on the move: Jenny Bjork from Padre Island to Virgin Islands; Steve Cinnamon from Wupatki/Sunset Crater to Midwest Regional Office, and Craig Hauke from Big Thicket to Canyonlands. Southwest Region's losses are the gains of these other regions. We wish them well.

Dr. Fletcher has been fostering an extensive GIS network for applications both here in the Regional office and in several parks; Bend Bend, Big Thicket, Guadalupe Mountains, and Carlsbad Caverns. These parks are the pilot, trial areas to which others will be added. This effort links with the inventorying and long-term monitoring Servicewide initiative (see p. 7).

Western Region

Vegetation and Floristics of Pinnacles National Monument is a 113-page publication, Tech. Report No. 34 from the CPSU at U/CA Davis. Authors William Halverson and Ronilee Clark surveyed 87 sites for physical features of habitat and the composition and structure of vegetation, described 13 plant communities, and analyzed the amount of ground disturbance caused by pig rooting. The California buckeye woodland (67%) and blue oak woodland (39%) were the most disturbed.

The Hawaii Environmental Education Assn. (HEEA), organized to foster increased effectiveness of EE in Hawaii, has elected officers, is incorporating and applying for nonprofit status. Chief Interpreter Kim Sikoryak (HALE) and Research Scientist Chuck Stone (HAVO) are directors; Stone is president. A catalog of EE programs in the state has been prepared and breakfast meetings to encourage networking were held on four islands in October.

A manuscript, *Alteration of Native Hawaiian Vegetation: Effects of Humans, Their Activities and Introductions*, has been submitted to U/HI Press for publication. Authored by Linda W. Cuddihy and Charles P. Stone, both of HAVO, the book reviews the changes in native Hawaiian vegetation from the arrival of Polynesian settlers to the present day. Effects of forestry, whaling, animal and plant introductions, fires, agriculture, and urbanization on native vegetation are among the subjects. The book will be available in Spring 1990.

Kalaupapa National Historic Park hosted an October meeting of NPS scientists, resource managers, and adjacent landowners to revise the resource management plan for the park. The principal issues and feral animal control, alien plant control, endangered species conservation, and aquatic resource protection. Management options are constrained by Hansen disease patient rights, cultural resource concerns, and a significant native forest that is a state natural area reserve within the park.

The final draft of the WR's Natural Resource Monitoring Program Development Plan on "how to develop a diagnostic ecological monitoring program" has been sent to all task force members. This plan was a product of the Inventory and Monitoring Initiative Workshop hosted by Channel Islands NP last September. Copies of the draft plan may be had from Marcia Schramm, Channel Islands NP Research Division, 1901 Spinnaker Drive, Ventura, CA 93001.

We also have completed our second printing of the *Channel Islands NP Natural Resource Monitoring Handbook* and are distributing them to interested park personnel. You may request copies of the handbook at the address above.

A scoping session was held at the Univ. of Nevada, Las Vegas (UNLV) Nov. 6-8, 1989, to assist Lake Mead NRA in identifying and prioritizing research and resource management needs. Gary Davis, Channel Islands NP, led the discussion of the step-down process. The session was attended by WRO scientists, UNLV faculty, Lake Mead resource managers, and members of the Desert Research Institute. Plans are to hold scoping sessions for Joshua Tree and Death Valley in the near future.

David Parsons, research scientist at SEKI, who recently was named a regional contact for global climate change issues, represented NPS at a national meeting to pursue the use of existing long-term ecological research sites as focal points for new efforts to study predicted impacts of changing climate. The meeting, held in Denver No. 14-17, was organized by the National Academy of Sciences and the National Science Foundation LTER program. SEKI was the only NPS area invited to participate.

Dave Parsons and Thomas Stohlgren had a paper published in *Madrono* (Vol. 36:154-168) on "Effects of Varying Fire Regimes on Annual Grasslands in the Southern Sierra Nevada of California."

The SEKI research and resources management staffs participated in the October California Wilderness Conference in Vaslia, CA. Presentations were by Dave Parsons, on giant sequoia ecology; by David Graber, on research ethics in wilderness; by Nathan Stephenson, on global climate change; by Tom Nichols, on fire management, and by Harold Werner on bear management.

Thomas J. Stohlgren (CPSU, U/CA Davis) recently published two papers in the book: *The California Chaparral: Paradigms Reexamined*, edited by S.C. Keeley (Natural History Museum of Los Angeles County Science Series No. 34, Los Angeles, CA; 1989). The first paper, co-authored by Philip W. Rundel (UCLA) and David Parsons (SEKI), "Stable Population Size Class Distribution in Mature Chamise Chaparral," investigated the population attributes and ecosystem processes that influence chamise chaparral. Chamise (*Adenostoma fasciculatum*) is the dominant shrub species in California and in the foothills of Sequoia and Kings Canyon NPs. The second paper, "Fire and Demography," co-authored by Jon E. Keeley (Occidental College), and Paul H. Zedler and Charles A. Zammit (San Diego State/U), discusses evidence contrary to the current paradigm that 20 year fire return intervals are necessary for chaparral persistence.

Stohlgren also published a paper in *Environmental Management* (1989, Vol. 13(4):485-491) on "Effects of Herbage Removal on Productivity of Selected High-Sierra Meadow Community Types." Co-authors were Parsons and Steve DeBenedetti (PINN). The study documented that long-term intensive herbage removal was detrimental to three subalpine meadow community types in Sequoia and Kings Canyon NPs.

Water Resources

WRD professionals attended several meetings this fall and presented the following papers:

"Community metrics to detect community stress," (T. Boyle); "Methods to assess toxicity in three Rocky Mountain streams," (D. Nimmo); "Evaluation of non-point sources of pollution at Ft. Darling unit, Richmond National Battlefield park, (Nimmo/T. Craig); results of research on the effect of old logging dams on the ecology of the Namekagon River and the use of tributary mouths as sites to deter non-point source pollution on the St. Croix mainstem (Boyle).

Two poster sessions were presented by Boyle and Nancy Hoefs: one on the interim results of the inventory and monitoring program on the St. Croix and one on new statistical applications of the Index of Biological Integrity applied at Ozark National Scenic Riverways.

The WRD took part in the Desert Parks Workshop in Tucson, AZ in October to identify desert park management issues and suggest approaches for dealing with them. The workshop was coordinated through the Albright Training Center and attended by personnel from most desert parks, three Regions (RMR, SWR, and WR) and several WASO offices.

regional highlights

Outstanding National Resource Waters: A Resource Management Tool, explains how park personnel can use State antidegradation policies and programs to protect park resources. The report, a WRD publication, includes a State-by-State analysis of anti-degradation and Outstanding National Resource Waters program provisions, and is available from the WR Division, NPS, Colorado State Univ., Aylesworth Hall, Fort Collins, CO 80523.

* * *

Ray Herrmann recently returned from a month in the Soviet Union where he was involved in joint field studies at the Oka Reserve about 300 km southeast of Moscow. The purpose of this cooperative US/USSR effort was to compare and agree upon data collection methods for use in long-term ecological observations. US participants, including Dave Graber of NPS, Lindsay Boring of the University of Georgia, and Robert Pierce of USFS, Hubbard Brook Experiment Forest, shared thoughts and discussions both theoretical and practical about theories of biodiversity, landscape diversity, forest stand dynamics, soils hydrology, and climate.

Two tasks set for this change were (1) to develop and calibrate a "system of measures of biodiversity" to provide for baseline monitoring and to provide for comparison of ecosystems using the Oka Reserve as an example; and (2) to develop recommended plans for monitoring ecosystem change in Biosphere Reserves. While at the Oka Reserve the American Soviet scientists accomplished task 1 and made good progress towards fulfilling task 2.

Midwest Region

Apostle Islands NL hosted its 11th annual research conference in Bayfield, WI in November. The conference features ongoing studies at the Lakeshore, with 14 presentations. Topics ranged from early agriculture in the Apostles to water-quality of Lake Superior. Abstracts of the proceedings will be published by the NPS.

* * *

On Sept. 14, 1989, the USFWS issued a final rule that determined both the eastern and western prairie fringed orchids threatened. The western species has been photographed at Pipestone National Monument in Minnesota, but the location of the plant or plants is unknown. We believe funds will be available in 1990 to conduct a field survey to verify the presence of this threatened orchid at Pipestone.

* * *

The Science Museum of Minnesota's Saint Croix Field Research Station funded a gathering of scientists/scholars at Wilder Forest, Marine On Saint Croix, MN in October to discuss and share their research findings. Saint Croix National Riverway co-hosted the Rendezvous. Dick Weisbrod chaired the program.

Over 80 researchers and resource managers from federal, state, county, and private agencies and institutions responsible for natural resources management in the 22,000 km² Saint Croix Basin participated. Several congressional district offices were represented. The meeting was kept in order and the 20 papers kept on time with a makeshift gavel, a rusty machete.

(It was rumored the usual meeting gavel was misplaced during the Rendezvous' semi-organized Frolic and Palaver, on the preceding evening, while thwarting the native wildlife's attempted snatching of hors d'oeuvres.)



Gateway NRA in the North Atlantic Region, celebrated the completion of its newly created pond (see p. 6) with a toast by (from left): John Tanacredi, Gateway research ecologist; Gil Barnes, acting regional administrator of the NY Dept. of Environmental Conservation; Mike Matthews (also NYSDEC); Gateway Supt. Robert McIntosh, Jr.; and Gateway Resource Manager Bob Cook.

Academic session topics ranged from archaeology to zoology with a dominant focus on aquatic biology. Introductory papers discussed the unusually diverse biota in the Saint Croix Valley (e.g. unionid mussels, odonate insects, basalt prairies, etc); later papers dealt with specific management issues such as native prairie maintenance, aquatic snag management, and rare species-recreation use conflicts.

Troll Surveys, Ltd. (developers of the famous TS Index) polled participants' response to the Rendezvous and obtained a Technical Meeting Index of a strongly positive 4.85. The Science Museum and the riverway are already planning next year's Saint Croix River Research Rendezvous.

WASO

From Integrated Pest Management in the NPS Washington Office comes word that USFS has funded all but three of the Forest Insect and Disease suppression proposals submitted by NPS, for a total of about \$600,000. The Forest Service also has indicated it can provide field personnel to assist with the unfunded projects.

* * *

Gary Johnston, IPM director, recently briefed several Congressional staffs on the NPS Integrated Pest Management program, on turf management, and on mosquito management policy. He also spoke on exotic species management at the annual meeting of the Natural Areas Association. His 40-hour course given recently for the Natural Resource Management trainees was audited by a Bureau of Reclamation representative. BuRec may ask NPS to teach this IPM course to its employees; BLM and FWS also have expressed interest in the course.

* * *

An annotated list of endangered species for which the NPS plays a key role in protection has been completed and is being mailed to all Regions. Many of the species will be featured in a new brochure being prepared. The NPS manages many of the designated critical habitats and in some cases protects the only populations.

Computer Corner

The Technical Information Center (TIC) at the Denver Service Center (DSC) is the result of over 25 years of planning, developing, and refining a microfilm storage system and computerized information system that is used to manage the NPS's technical information. The information database is computerized to provide manipulation and retrieval capabilities and the source document itself is microfilmed for both storage and document delivery. The system is capable of accessing the vast amount of technical information holdings of the Service, and of supplying details of what information is available, what format it is in, and where it is stored. DSC-TIC has been designated by the Service as the central repository for all NPS-generated planning, design, and construction maps, drawings, and reports as well as related cultural, environmental and other technical documents.

Bibliographic data relating to the documents/drawings/maps/aerial photographs are entered into a mainframe computer. Outputs which list entire holdings by park and arranged by subject or location within park are distributed annually to NPS regions, WASO, HFC, park superintendents, archeological centers and other field offices as requested.

Currently, a contract to convert the database to an in-house system which may include a local area network is underway. When the contract is completed, the TIC database will be electronically accessible to the parks, regions, and WASO offices.

Today, the system has a holding of 100,000 data records, which represent about 500,000 microfilm aperture cards of maps, plans, and drawings; 1,000 records of resource and site aerial photography; and 25,000 planning, design, environmental, cultural resource and natural resource documents.

If you are interested in further information, contact Edie Ramey, Chief, Technical Information Center, Denver Service Center, FTS 327-2130 or (303) 969-2130.

Kemp's Ridley Project at Padre Island Enters a New Phase

By Donna J. Shaver

For the last decade the annual arrival of endangered Kemp's ridley sea turtle (*Lepidochelys kempi*) eggs from Rancho Nuevo, Mexico was anxiously awaited at Padre Island National Seashore (PAIS). Eggs were sent to the park each summer from 1978-1988, in an international multi-agency attempt to establish a secondary breeding colony of this species through imprinting. This experiment, originally scheduled to be conducted for 10 years, is now undergoing changes and entering a new phase. Eggs will no longer be sent to the park from Mexico. Attention will now focus on continuing public education about sea turtles, patrolling the beaches for nesting turtles and protecting any nests found.

The Kemp's ridley is the most endangered and restricted sea turtle species. Virtually the entire population nests on a single 14 mile stretch of beach near the village of Rancho Nuevo, Tamaulipas, Mexico. It is estimated that 40,000 females nested in a daytime aggregation (arribada) filmed there in 1947. By 1966, when biologists finally learned the location of the nesting beach and began protection, only 3,000 to 5,000 females nested in the largest arribadas. Despite conservation efforts, probably fewer than 700 females nested there during the entire 1989 nesting season. Causes for this sharp decline include the harvest of adults for meat and leather and of eggs for use as a supposed aphrodisiac. Incidental capture of these turtles in fishing and shrimping trawls is also thought to have reduced their numbers.

Project Background

In 1978, the Kemp's Ridley Sea Turtle Restoration and Enhancement Project was undertaken by the Instituto Nacional de Pesca de Mexico, U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries (NMFS), National Park Service (NPS) and Texas Parks and Wildlife Department in accordance with Section II of the Endangered Species Act. One of the goals of the project was to establish a secondary breeding population of this species at Padre Island. Padre Island NS was chosen because the species had been known to nest there historically and because the NPS would be able to provide some protection in the event that a new breeding population became established.

Each summer, from 1978-1988, about 2,000 eggs (20 clutches) were collected at Rancho Nuevo as they were laid, placed in styrofoam boxes containing Padre Island sand and transported via aircraft to the national seashore. The styrofoam boxes were placed in an outdoor predator-proof, screen enclosed incubation shed. The overall hatching rate of the 22,507 eggs sent to Padre Island during the 11 years was 77.1 percent (Table 1). Yearly hatching rates ranged from 12.1-91.6 percent (Table 1).

Hatchlings were released on the beach at Padre Island and allowed to crawl down the beach, enter the surf and swim approximately 10 yards where they were recaptured using aquarium dip nets. A total of 278 hatchlings (1.7 percent) escaped in the surf during release and 381 hatchlings (2.2 percent) died at Padre Island either prior to or after release (Table 1).

From 1978 through 1988, 15,875 recaptured hatchlings were transported to the NMFS laboratory in Galveston, Texas for one year of "head starting" (Table 1). This time in captivity allowed them to grow to a size large enough to avoid most predators and to be tagged for future recognition. Overall, approximately 80 percent of the hatchlings survived head starting. Most of



One of the Kemp's ridley hatchlings released at Padre Island NS beach every summer from 1978 through 1988.

these head started turtles (approximately 12,000) were released offshore from Padre Island.

Research

A number of parameters were monitored on eggs and hatchlings at PAIS. Data were collected on incubation temperatures, sex ratios, embryonic mortalities and hatchling lengths and weights to evaluate incubation conditions and clutch and year class viability to improve management techniques. Much of the data had never been amassed for this species and had significant management implications and applications at the park and Rancho Nuevo. In fact, park employees traveled to Rancho Nuevo to train new beach workers on techniques we developed to monitor and modify incubation temperatures and to examine unhatched eggs.

Research at the park elucidated the importance of temperatures of incubating Kemp's ridley eggs. Incubation temperatures were found to affect sex ratio, with higher temperatures producing more females (Shaver et al. 1988), and embryonic survivorship, with excessively high, low and fluctuating temperatures reducing survivorship (Shaver in press, Shaver and Chaney in press). The matching of clutch incubation temperatures and sex ratios for several year classes of eggs allowed us to further define the incubation temperatures at which the eggs should be maintained (Shaver et al. 1988). During the later project years, techniques were developed to alter incubation temperatures so that a 1:1 sex ratio or slightly more females were produced. Although slightly more males were produced during early project years, slightly more females were produced during later project years (Shaver et al. 1988) and collectively a 1:1 sex ratio was attained. Incubation durations and percent females were correlated to derive an equation that could be used to predict percent females for a particular clutch when given its incubation duration (Shaver in press).

A beach temperature profile study was undertaken to determine temperatures at which Kemp's ridley eggs would incubate if laid in Padre Island sand and to predict seasonal trends in sex ratios. Temperatures from three sites on Padre Island were compared with temperatures from Rancho Nuevo. It was found that

Rancho Nuevo and Padre Island sand temperatures were comparable during the summer months of heaviest nesting activity and egg incubation (Shaver et al. 1988). Clutches undergoing their middle third of incubation (when sex is determined) early in the nesting season at Padre Island or Rancho Nuevo should produce primarily males, later portion of the season primarily females, and middle of the season a mixture.

Unhatched eggs were examined to quantify fertility rates and embryological stages of development at time of death. By staging embryos obtained from these eggs, we could estimate time of death and relate it to the sequence of activities involved in the Restoration and Enhancement Program. Excessive sand moisture and/or fungal contamination led to the high early staged mortality in the 1983 year class. Also, high and excessively fluctuating temperatures led to relatively high late staged embryonic mortality in a number of clutches in the 1985 and 1987 year classes (Shaver in press, Shaver and Chaney in press). These findings were incorporated into the development of techniques to modify incubation temperatures so that they would not reach injurious levels. The techniques were employed during the 1988 Kemp's ridley incubation season and the hatching success of the 1988 year class (91.6 percent) was the highest of all project years (Table 1).

Beach Patrols and Nestings

The age at which Kemp's ridleys mature is unknown, but estimates range from 8 to 15 years. Since females from the early project years may begin returning to Padre Island to nest, systematic beach patrols for nesting turtles and tracks, initiated in 1986, were continued during 1987, 1988 and 1989. Patrols were made during daylight hours in an attempt to detect daytime nesting Kemp's ridley turtles. It was also hoped that nesting by sea turtles not a part of this project (including Kemp's ridleys, loggerheads and greens) would also be detected during these patrols.

Patrols were conducted from the ranger station to the Mansfield Channel and back, covered a distance of about 120 miles and required at least eight hours. Three to four patrols were made each week from mid-April through August in order to encompass the entire Kemp's ridley nesting and incubation season and much of the green and loggerhead nesting seasons. Although most patrols were done in a four-wheel drive truck, a Coast Guard Auxiliary airplane and a National Guard "hummer" (a military all-terrain vehicle) were used to conduct patrols once a week during the later part of the 1989 patrol season.

Although a number of tracks, nesting turtles and nests have been found on the Texas coast during the past 11 years, no confirmed head-started *L. kempi* have nested on Padre Island to date. However, it is unknown how many have survived after release or whether any have attained adulthood. Many reports and sightings of nesting turtles and tracks have failed to yield nests. However, eight sea turtle nests found during patrols or reported by visitors were documented on Texas beaches from 1979 through 1989 (Table 2). Five Kemp's ridley, two loggerhead and the first green turtle nest confirmed on the Texas coast (Shaver 1989) were found. Four of the eight confirmed nests were constructed on the national seashore. Three of these were relocated in styrofoam boxes to the park incubation facility because they were located in areas where they might have been destroyed. Eggs from three of the four nests that were constructed outside the sea-



Beach patrols for nesting sea turtles are conducted from mid-April through August at Padre Island NS. It is hoped that Kemp's ridley turtles soon will return to nest there.

Table 1. General results of 1978-1988 Kemp's ridley incubation and imprinting at Padre Island National Seashore.

Year	Number clutches from Rancho Nuevo	Number eggs from Rancho Nuevo	Number (percent) eggs hatched	Number (percent) hatchlings died at Padre Island	Number (percent) hatchlings lost during release	Number hatchlings to Galveston	Mean incubation period (days)
1978	17	2,191	1,931 (88.1)	64 (3.3)	19 (1.0)	1,848	51.5
1979	20	2,053	1,769 (85.7)	15 (0.9)	93 (5.3)	1,661	52.0
1980	32	2,976	2,502 (84.1)	14 (0.6)	65 (2.6) ^a	1,611	50.5
1981	23	2,279	1,898 (83.3)	11 (0.6)	19 (0.8)	1,868	48.3
1982	20	2,017	1,563 (77.6)	5 (0.3)	34 (2.2)	1,524	51.0
1983	18	2,006	242 (12.1)	10 (4.1)	2 (0.8)	230	52.0 ^b
1984	19	1,976	1,792 (90.7)	239 (13.3)	9 (0.5)	1,544	51.1
1985	20	1,978	1,664 (84.1)	13 (0.8)	25 (1.5)	1,623 ^c	48.8
1986	22	2,011	1,776 (88.3)	1 (0.1)	16 (0.9)	1,759	46.7
1987	20	2,001	1,288 (64.3)	5 (0.4)	1 (0.1)	1,282	47.6
1988	10	1,019	933 (91.6)	4 (0.4)	4 (0.4)	925	46.9
Total	221	22,507	17,358 (77.1)	381 (2.2)	287 (1.7)	15,875	49.7

^aCalculated excluding 810 hatchlings from 11 clutches intentionally released into the Gulf of Mexico.

^bCalculated based only upon the 9 clutches that hatched.

^cCalculated excluding 69 hatchlings from a Padre Island natural nest head started at the Galveston NMFS laboratory.

Table 2. Documented sea turtle nestings on Texas beaches from 1979 through 1989. PAIS = Padre Island National Seashore, Padre Island, PBP = Padre Balli Park, Padre Island, SPI = South Padre Island and MI = Mustang Island.

Species	Number of eggs	Lay date	Nesting location	Incubation location and method	Percent hatch
Loggerhead	84	15 June 1979	SPI	SPI, nest site	1
Kemp's ridley	67	17 June 1979	PAIS	PAIS, styrofoam box	97
Kemp's ridley	113	30 April 1980	PBP	PAIS, styrofoam box	55
Kemp's ridley	115	22 May 1980	PAIS	PAIS, nest site	2
Kemp's ridley	97	13 June 1985	PAIS	PAIS, styrofoam box	72
Green	2	13 July 1987	PAIS	PAIS, styrofoam box	50
Kemp's ridley	104	27 April 1988	MI	PAIS, styrofoam box	91
Loggerhead	113	27 June 1988	MI	PAIS, styrofoam box	69

shore were also deemed to be threatened and were placed in styrofoam boxes and incubated at the PAIS facility (Table 2).

Because of our expertise, the park has taken the lead in sea turtle nest detection and protection for the Texas coast. The park recently prepared an action plan that details threats to nesting turtles, nests and hatchlings, measures that can be used to protect them and recommendations for dealing with eggs and hatchlings from nests laid on PAIS. The plan also outlines sug-

gested procedures that could be followed if nesting activity is found on other Texas beaches. Procedures recommended in the plan for dealing with nesting activity vary with different nesting levels. The basic recommendation is that sea turtle eggs should be left at the nest site (*in-situ*) if they can be protected from threats and that hatchlings should be released there. If few clutches are laid and cannot be protected *in-situ*, they will be incubated in styrofoam boxes at the park incubation facility. Larger numbers of nests that cannot

be protected *in-situ* will be placed into corrals where feasible and where trained personnel can monitor them.

Public Education

Efforts to educate the public about the Kemp's ridley project and sea turtle conservation began in 1978 and continued through 1989. Interpretive programs were given at most hatchling releases from 1978 through 1988. Also, handouts, posters and displays describing the project were made and the project was frequently covered by the media during all project years. Beginning in 1986, increased efforts were made to educate the public about the potential for nesting Kemp's ridley turtles and urge them to look for and report turtles and tracks. Since the national seashore is 65 miles long and extensive areas are often devoid of NPS personnel, it is imperative that park visitors assist with turtle detection and reporting. In 1989, magnetic signs alerting visitors to report all live sea turtle sightings were affixed to patrol vehicles. The signs elicited very positive responses from visitors and resulted in a number of reports of turtle sightings. Also, a video describing the Kemp's ridley project and what visitors should do if they see nesting turtles or tracks was shown continuously at the new park Visitor Center after its opening in July 1989.

Future Program Efforts

Pursuant to a decision made by the Kemp's Ridley Sea Turtle Working Group in 1987, no additional Kemp's ridley eggs will be transferred from Rancho Nuevo to Padre Island after 1988. Since the Kemp's ridley population is still declining at a rate of 3-4 percent per year, the group felt that additional emphasis should be placed on protecting the nesting turtles and nests in Mexico. Additionally, the Padre Island portion of the Restoration and Enhancement Program was originally designed to last only 10 years and that time was up. The PAIS sea turtle project will now focus on determining if Kemp's ridleys return to South Texas to nest and protecting, documenting and monitoring any nesting sea turtles and nests that are found. Central in our efforts will be the continuation of beach patrols and public education.

Shaver is a Natural Resources Management Specialist at Padre Island National Seashore.

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A unique laboratory, quarantine station, and greenhouse complex, hidden in the dense rain forest within 100 yards of the brink of an active volcano near the visitors center at the crater of Kilauea NP is described in the Sept. 21, 1989 issue of the Portland **Oregonian**, by Leverett Richards. George P. Markin of the USFS is in charge of the research program there, where more than 100 insects are being studied for possible use in protecting and restoring Hawaii's natural forests.

"Using nature to fight nature is the only sound, permanent control," Markin says. Biological control is not cheap – "it takes 5 years and \$1 million to develop a safe, effective bio agent," Markin claims, and if any of the 10,000 or so insects quarantined in his research complex were to escape, "they might do as much harm as an A-bomb."

It takes about 2 years of testing to satisfy about 38 different agencies that they will eat "only off their own plates," Markin explains. No entomologist wants to make "the mongoose mistake." (The mongoose, introduced in 1873 by ranchers to control rats is now a bigger pest than rats, living on the eggs and young of native birds.)

A small blue moth, tested at the facility, was released during the past year to combat Hawaii's most incredible forest enemy – the banana poka, or *Passiflora molissima*. It grows with incredible speed, climbs the tallest trees and topples them by its sheer weight. "It will even kill koa and ohia – Hawaii's principal hardwood trees, 100 feet tall," Markin says. "If the blue moth doesn't slow it down, we will lose most of our remaining forest within 50 years."

An illustrated 72-page book with full color cover, **National Parks and Tourism**, contains the proceedings of a seminar held in Sydney, Australia in May 1988, co-sponsored by Australia's NSW National Parks and Wildlife Service and the Royal Australian Institute of Parks and Recreation (NSW Region). It contains a summary of the workshops, six papers, and the conclusion that communication is the key to identifying and nurturing the common ground between tourism and conservation. Copies are \$19.95 and may be ordered from NSW National Parks and Wildlife Service Shop, PO Box 1967, Hurstville NSW 2220, Australia.

From UNESCO's **Courier**, January 1989, comes an article about a US-funded project in Malaysia and China by a US ecological group called Integrated Conservation Research (ICR), aimed at demonstrating that rain forests are more valuable if used on a sustainable basis than if cut for immediate, short-term profit. The ICR-supported project is divided into agroforestry, ethnobotany, and natural history oriented tourism.

It was found that tea plants, when planted between rows of trees, become more productive and that two species together also supported a "community" of more than 100 species of spider – more efficient than insecticides as pest controllers.

Most striking among the animal species studied was the forest-dwelling cattle known as the gaur (*Bos gaurus*). These nearly extinct animals are highly prized for their meat, which is low in cholesterol and comprises 65 percent of the carcass – about 2 metric tons each. The gaur is the only species of bovid that sweats, and their sweat contains repellents against flies, ticks, and other ectoparasites. It does not require grass for food, being a browser of forest edge plant species; consequently, forests do not need to be destroyed to propagate the gaur.

The author, Illar Muul, is an American ecologist and research associate of the Smithsonian Institution, and president of ICR.

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The Natural Resource Publication Office of the National Park Service announces the following new publications, available from Publications Coordinator Donna O'Leary, c/o Air Quality Division, PO Box 25287, Denver, CO 80225-0287:

Transactions and Proceedings

1. *Issues in Biological Diversity*. Dominic Dottavio, editor.

2. *Proceedings of Research in California's National Parks*. NPS CPSU, U/Cal/Davis, 3rd Biennial Conf. on Research in California's NPs. Techniques for monitoring fauna and flora.

Technical Report Series

1. *Tamarisk Control in Southwestern United States*. Michael R. Kunzmann, R. Roy Johnson, and Peter S. Bennett, tech. coordinators. Proceedings of the Tamarisk Conf., U/AZ, Tucson, Sept. 2 and 3, 1987. NPS D-94.

2. *Behavioral Responses of Summering Humpback Whales to Vessel Traffic: Experimental and Opportunistic Observations*. C. Scott Baker. NPS D-428.

3. *Natural Resources Monitoring Handbooks, Channel Islands NP, CA*. Gary E. Davis and William L. Halvorson. Example of ecological monitoring design. 602 pp. 1988. Second Printing 1989.

Annual Science Report Series

1. *1988 Annual Science Report*. Anne Frondorf, editor. Inventory of 1988 research. (approx. 100 pp.)

Natural Resource Report Series

1. *1988 Highlights of Natural Resources Management*. Donna O'Leary, editor. A report on NPS natural resource management activities in 1988. 35 pp. 1989. NPS-NR-89-01. NPS D-426.

2. *NPFLOA User's Manual*. Gary Waggoner. User's manual for the National Park System's vascular flora database. 52 pp. 1989. NPS-NR-89-02. NPS D-427.

3. *Outstanding National Resource Waters: A Natural Resource Management Tool*. Barbara West. EPA antidegradation policy and Outstanding National Resources Waters program and how they relate to NPS resource management. A state-by-state listing and evaluation of antidegradation provisions. 35 pp. 1989.

4. *Mineral Laws and Regulations and the National Park System*. Carol McCoy. Overview of types of mineral rights that exist in park units, laws and regulations government development of these rights, and some options for park resource managers to protect park resources and values from mineral development inside park boundaries. NPS/NRMMB/NRR/89/01.

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The oldest earth rocks discovered so far were announced Oct. 4, 1989 by Thomas O. Wright, program manager at the National Science Foundation. Samuel A. Bowring of Washington University in St. Louis, senior scientist on the project, said the rocks, found in northern Canada, are 3.96 billion years old. This makes them 100 million years older than the previous record holders, found in Greenland and Antarctica. In Canberra, Australia, Bowring studied his rocks with the Sensitive High Mass-Resolution Ion Microprobe, known as SHRIMP – one of the most

sensitive isotope dating instruments in the world. Since several lines of evidence establish the age of the solar system at 4.5 billion years, the rocks recovered by Bowring's team were formed on Earth when the planet was only about half a billion years old. Furthermore, they are granite, which is an "evolved rock," meaning that they had to be derived from an even older rock, Bowring pointed out.

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Tony Slingo, scientist with the Climate and Global Dynamics Division of the National Center for Atmospheric Research, describes in the Sept. 14, 1989 issue of **Nature** how variations in cloudiness can significantly affect the Earth's radiation budget – the absorbed solar energy and the thermal energy radiated back to space. He describes the various modeling studies that support this conclusion and observes: "The substantial sensitivity of climate models to the details of their formulation, and the fact that 14 models give 14 different answers for the cloud feedback, show that we are far from the goal of accurate predictions of future climate change." It will be several years, he predicts, before reliable predictions of global and regional climate change are available from the models, and he cites the need for "comprehensive monitoring that is capable of unravelling the climate change signal from the noise ..." Such an analysis, he concludes, "may well yield the 15th answer, but at least it will have come from the real world and will permit a much needed test of the models."

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"Ethics debate sends tremors through USGS" reads the headline over a story in the Nov. 3, 1989 issue of **Science**, describing the confrontation between Howard Wilshire, a USGS geologist, and the federal agency for which he works as a scientist. Wilshire's passionate interest in defending arid lands from the onslaught of off-road vehicles let him, as a private citizen, to advise (on his own time) an environmental group trying to prevent the USFS from building a playground for motorcyclists in California's El Dorado NF. He even suggested at one time that the group subpoena him as a USGS expert, though federal employees are not allowed to testify as experts against the government.

"The case highlights a problem that is likely to arise again and again for scientists in public service," writes **Science** author Eliot Marshall. "Because of their expertise, they may have – or believe they have – the best insight into a scientific issue that has become embroiled in public debate. But if their view happens to clash with the position taken by responsible officials, they face some difficult choices: they may keep silent, speak out at risk of punishment, or resign. The middle option is perhaps the most satisfying, but also the trickiest to negotiate, for the rules are always changing."

In this case, Wilshire's boss tried to suspend him for misconduct – an action that was overturned. But the issue is an increasingly pertinent one, with one of the questions being "Should the public have access only to the information that an Administration wants to release?" (This question was posed by Brent Dalrymple, a colleague of Wilshires at the USGS office in Menlo Park, CA.)

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David Manski, Supervisory Resource Management Specialist at Cape Cod NS, calls attention to a number of essays in the most recent issue of **Wildlife Society**

BioScience Focuses Issue on Yellowstone

A "representative sampling of Yellowstone fire articles that had appeared by the summer of 1989 went to all NPS units from Yellowstone Park Supt. Bob Barbee on Aug. 15, 1989. Since that time, an October 1989 issue of **BioScience** (Vol. 39 No. 10) has devoted 44 pages to the fires.

"Fire Impact on Yellowstone," by 13 authors including many NPS scientists, summarizes the findings of the Greater Yellowstone Coordinating Committee (representatives of the 6 NFs and 2 NPs that comprise the Greater Yellowstone Area). The complete report is available from the GY Coordinating Committee, Division of Research, PO Box 168, Yellowstone NP, WY 82190. The report evaluates the ecological impacts and implications of the fires in relation to watersheds, fisheries, wildlife, vegetation, soils, and biological diversity, considers the need for interventions such as reseeding (to prevent erosion), reforestation, and supplemental feeding of ungulates, makes recommendations for short- and long-range programs, and considers alternatives and options for future fire management plans.

Romme and Despain provide "Historical Perspective on the Yellowstone Fires of 1988;" Knight and Wallace discuss "Issues in Landscape Ecology" in the light of the fires; Minshall, Brock and Varley write about "Wildfires and Yellowstone's Stream Ecosystems," and "Drought, Fires, and Large Mammals" are the subjects of an article by Singer, Schreier, Oppenheim, and Garten.

Paul Schullery considers the history of fire policy in the USFS and NPS and the problems arising from the fact that these policies were practically unknown outside of specialized scientific and conservation communities.

"It has proven difficult," he writes, "for the public to separate the scientific interest and aesthetic wonder of their (the fires') ecological effects from the conservation of their political and economic effects."

Clearly, a job for interpretation.

Romme and Despain reconstruct prehistoric fire records, showing that comparable fires occurred in the 1700s, and conclude that the recent 30-odd years of attempted fire exclusion practiced by the USFS and NPS only served to "delay the onset of a major fire event, which probably was inevitable given the nature of the fuels complex that had developed since the last extensive fires in the 1700s."

Knight and Wallace take the landscape perspective, one they present as "necessary in resolving the difficulties of natural area management." They consider temporal and spatial scales in Yellowstone, temporal

and spatial patterns in terrestrial vegetation, shifting animal distribution, land-water-nutrient interactions, and research opportunities.

Minshall, Brock, and Varley maintain that the fires' effects "are likely to be most pronounced in headwaters." Singer, Schreier, Oppenheim, and Garten found 261 large mammals dead directly after the fires – less than 1 percent kill; but winterkill of elk following the fires was 50 percent in one district (the Madison-Firehold winter range, where fire had affected 41 percent of the area); calf weights were down and mortality rates were up significantly the following spring (1989).

In all instances, the authors conclude on a note of recognition that the Yellowstone fires, for all their profoundly jarring notes, represent one of the rare opportunities in the history of modern ecology to examine the effects of fire.

Articles by RMR Chief Scientist Dan Huff and by Yellowstone NP Science Writer Paul Schullery appear in the GWS FORUM (Vol. 6 No. 3) and deal with the public perceptions of the Yellowstone fires. Huff quotes the **Wall Street Journal's** assessment of the fires' management ("mindless bungling") and adds a quote from Thomas McGuane: "Anything that makes the world look better to animals and worse to humans is probably good." Huff ends with another quote, this time from Texas Agriculture Commissioner Jim Hightower, rejecting fence-straddling on the issue as intellectually untenable. "There is nothing in the middle of the road," said Hightower, "but yellow lines and dead armadillos."

Schullery's article deals with "Lessons and Hopes from the Yellowstone Fire Media Event." He concludes that the medium IS the message and that "we must be prepared to work with, not against, the established conventions of modern media." The challenge, says Schullery, "is to inspire readers (and viewers) to a fuller appreciation of what the images really mean."

David Snepenger, an associate professor at Montana State University's college of business, submitted a report on Nov. 6, 1989, on marketing Yellowstone NP after the fires of 1988. According to Schullery and Varley, who forwarded the report to **Park Science**, the majority of respondents to Snepenger's visitor survey thought the park was severely to moderately burned. However those that had been to the park since the fires thought the park was not as burned as those who had not been there.

Snepenger concludes that NPS "needs to present an enduring message to visitors about the role that fire plays in a forest and the managerial guidelines under which the Park Service operates."

mentary on representative government." Indeed, he says: "One does not for long belabor the imperfections of government without a sense of plagiarism," so well-trodden has the path of social reform become.

But he calls upon us, "the proprietors of today," to remind ourselves that we are also ancestors, "and therein we aspire to a respectable record." He laments our continuing to perpetuate traditions of short-term gains without regard to future generations or to where we bury our toxic garbage.

"The overwhelming issue," he writes, "is whether we have an obligation of frugality and good management – whether we have the privilege of overdraft on resource capital that could go on yielding if we handle it right. In times immediately ahead, we will devise an inheritance to people even more numerous than we – a situation of our creating. Do we take refuge in uncertainty and pretend not to know the facts?"

This ethical problem, Allen concludes, "one way or another will have an ethical answer."

Allen's favored solution is to view the Bill of Rights as a job unfinished. "The societal exponentials of complexity, competition, and stress have vastly changed the lives of people now living . . . If the right of a citizen to a pleasant and productive environment were constitutionally recognized, it would give notice to the overly ambitious that public properties are not up for grabs. It would establish in our government a compelling charge that these ramparts we watch are to be defended."

In a superb 1986 Simon and Schuster book, **Life Above the Jungle Floor**, by Donald Perry, the author describes his Central American research odyssey in the tropical forest canopy of Costa Rica's Osa Peninsula . . . "the most botanically diverse ecosystem on the planet . . . an intricate factory of evolutionary ideas that has transformed the earth's life." He describes the "incredible reservoir of undiscovered plant-protective chemicals, all as different as the vast range of canopy plants" and bemoans the fact that "drug companies have not even scratched the surface of exploring a jungle's pharmacological wealth" even though an estimated \$40 billion worth of drugs sold each year contain active chemicals from plants. On page 79, Perry credits Nalini Nadkarni of U/Cal with discovery that many tropical trees have "crown roots" growing from their limbs, picking up nutrients from the limb soil that collects in the mats of epiphyte roots. "In effect," Perry says, "Epiphytes pay 'rent' in the form of nutrients, a commodity in short supply throughout the forest."

Nadkarni was featured in **Pacific Park Science**, (Vol. 1 No. 3 of the series that became **Park Science**) for her work in the canopies of the Olympic NP rain forest.

The Nov. 6, 1989 issue of **The Nation** carries an article by Victor Perera (author of **Rites: A Guatemalan Boyhood**), entitled "A Forest Dies in Guatemala." He describes logging operations that are continuing in the majestic Sierra del Lacondon, a 2,358-square-mile reserve of dense rain forest containing the last large stand of giant hardwoods in Guatemala's northern region of El Peten – "the Sawmill of the North."

A law signed in January 1989 converted close to 15 percent of Guatemala's territory into a system of 50 ecological parks and biosphere reserves and created a National Council of Protected Areas to administer

Continued on page 16

Bulletin (17:3) with strongly contrasting opinions by some Wildlife Society members and members of the newly formed Society for Conservation Biology. The articles, says Manksi "are extremely interesting reading and provide some good philosophical discussion about the current state of the wildlife profession and its interaction with conservation biology."

An NPS videotape entitled "For the Long Run," winner of the prestigious CINE Golden Eagle Award, is now available for public showing. The film, copies of which have been sent to all NPS Regional offices, shows acid rain watershed studies in two NPs and discusses the value of long-term monitoring and research for measuring the health of NP ecosystems.

Highly recommended by Gerry Wright and Gary Machlis, both of the NPS/CPSU at U/ID, Moscow, a new book edited by Rob Moore and published by Solstice Press of P.O. Box 9223, Moscow, ID. Its intriguing title is **The Field Guide to Outdoor Erotica**, with contributions by such well-known outdoor writers as Mike Frome. (ISBN number 0-932722-11-3.)

Durward Allen, professor of wildlife ecology at Purdue's Department of Forestry and Natural Resources, discusses "Social Morality and Resource Use" in the GWS FORUM, (Vol. 6 No. 4). Allen traces the stumbling history of publicly perceived "rights" and finds that "the tangled web thus woven is a distasteful com-

them. But the largest of 9 sawmills licensed to operate there already has marked 1,000 mahoganies for logging by year's end (1989) – this on top of the 40 percent loss in forest cover in the past 30 years and a 50 percent drop in annual rainfall.

"The coming destruction of Peten's rain forest will be as calamitous in its way as the burning of the Mayan codices in Yucatan nearly 500 years ago," Perera writes. Some day it will be looked back on, he suggests, "as a 'Great Dying,' surpassed only by the disappearance of the dinosaurs 65 million years ago."

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An article by Constance Miller and William Libby in **Restoration & Management Notes** (Vol. 7:1, 19-24) questions the National Park Service's "restoration" at Redwood NP through aerial seeding with species that "though native to the park, were introduced from exotic sources." In their article ("Disneyland or Native Ecosystems: Genetics and Restoration"), the authors see "too little attention paid to the issue of the genetic source of planting stock." They offer 7 recommendations to aid in planning restoration and reintroduction projects.

**

From Dick Weisbrod at the Spring Creek Field lab (St. Croix National Riverway) comes an old page from **Science** (Vol. 241:1437) with two pieces of possibly pertinent information: One suggests an international Author Nonproliferation Act (the world's record as of Sept. 16, 1988 seems to have been 192 authors from 20 institutions for a single article); the other was a civics quiz. "What do Burma, Liberia, and the United States have in common?" The answer is, "They're the last 3 countries on earth not using the metric system."

Science notes that the Omnibus Trade Act of 1988 gives federal agencies until 1992 to adopt the metric system into their business dealings.

Park Science asks its contributing authors to take note!

**

In "The Regeneration Gap," by Jim Erickson (in **National Parks** (Vol. 63, Nos. 7&8) the "vanishing giant saguaros" of the Rincon mountain plot in Saguaro National Monument are described. Botanist Raymond Turner and his USGS colleagues set up monitoring plots there in the 1960s. Turner began monitoring the plots again in 1989 and found remaining only 42 of the 213 saguaros plotted there in 1961, many of them in bad shape.

The good news is that 119 new saguaro plants were found, some 2 feet tall, "apparently representing a new population in the Rincon after a 60-year hiatus in production of seedlings."

**

Seen on a coffee mug owned by Supt. Dick Ring of the Delaware Watergap NRA:

"Lack of planning on your part does not necessarily mean an emergency on my part."

**

The Sept/Oct 1989 issue of **Defenders**, (a bi-monthly published by Defenders of Wildlife) carries a truncated article by Napier Shelton of the NPS Wildlife and Vegetation Division in the Washington office, titled "Park Wildlife Makes a Comeback." It describes how biologists across the nation are working to fill ecological gaps.

Because **Defenders** readers are most interested in animals, Shelton's original version was trimmed of its plant restoration content. However, the 22 typed pages of his original draft, plus 2 pages of appendix listing 97 recent or ongoing restoration projects in NPS units, has been distributed to the Chief Scientists in all 10 Regions and is available from them.

In an "author's note" to the field, Shelton says: "A fuller treatment might also have included restoration of air and water quality, which of course are important for biological health but involve entirely different management processes."

**

Public Television has proclaimed 1990 as "Year of the Environment." As part of the 20th anniversary of Earth Day, public television will air a 10-part series in the fall of 1990, under the heading "Race to Save the Planet." Planning coordinators are Roselle Kovitz and Deb Miller at Nebraska ETV, P.O. Box 83111, Lincoln, NE 68501-3111; 402-472-3611 (or 3575).

**

Gary Willson, NPS Midwest Region ecologist, calls attention of **Park Science** readers to "a somewhat controversial" (his words) article, "Is It Getting Stuffy in Here, Or Is It Just My Imagination?" The author, Andrew Solow, writes in **Chance**, a magazine published quarterly by Springer-Verlag New York, Inc., "about statistics and computing" and intended "for anyone who has an interest in the analysis of data."

The author claims that the recent warning "is no more striking than that of earlier periods during which human contributions to atmospheric CO₂ were negligible." Solow winds up his presentation (in Vol. 2 No. 3:40-46) with "a word about policy." One side, he says, "holds that, despite the uncertainties, the potential consequences of climate change are so great that we must act as if it is certain to occur (particularly if we do nothing to stop it). The other side, (which expresses itself more in inactivity than in debate) holds that the costs of action are so great that, because of the uncertainties, no action is justified."

"It is to this debate," he claims, "that statisticians may have the most to contribute by pointing out that a sensible approach need not ignore uncertainty, but should use it in balancing costs, benefits, and the value of information in the formulation of policy."

**

Brad Griffith, formerly of the University of Idaho faculty and now with a USFWS research unit at the University of Maine, is the lead author of an article on "Translocation as a Species Conservation Tool: Status and Strategy," in **Science**, Aug. 4, 1989 (Vol. 245: 477-480). Surveys of intentional releases from 1973 to 1986 of native birds and mammals to the wild in Australia, Canada, Hawaii, New Zealand, and the U.S. were conducted to document current activities, identify factors associated with success, and suggest guidelines for enhancing future work.

A second article stemming from the same research deals with translocations of birds exclusively and is scheduled to appear in an IUCN Technical Bulletin. A third treatment will provide a geographical analysis, list names of translocated species, and will be submitted to the **Wildlife Society Bulletin**.

Reprints of the **Science** article and requests for the two upcoming articles may be addressed to Griffith at 240 Nutting Hall, Orono, ME 04469-0125; (207) 581-2870.

On Oct. 24, 1989, the U.S. MAB Executive Committee reviewed the **U.S. Biosphere Reserve Program Development Plan**, which was written by six members of the old Biosphere Reserve Directorate under the chairmanship of Paul Risser. The plan's major goals include: building functional biosphere reserves (BRs) in the context of regional MAB/BR programs, and focusing research on biodiversity, human dimensions of global change, and integrated landscape development.

The Executive Committee strongly supported developing BR functions, emphasizing programs rather than new BR designations. The new directorates were requested to coordinate the planning of a workshop in 1990 involving BR managers to review and recommend modifications to the plan and opportunities for implementing it. U.S. MAB will consider these recommendations in developing the final plan.

Two significant developments have occurred in the **Southern Appalachian MAB Cooperative (SAMAB)**: the Environmental Protection Agency has joined the six original federal member agencies; and the SAMAB Foundation, a private, nonprofit organization established to receive funds for operating the cooperative, has been chartered in Tennessee. All that remains before the foundation can function is recognition of its nonprofit status by the IRS. Hubert Hinote, SAMAB's executive director, says he has received many calls from other regions requesting information about the cooperative, and his talks with professional groups in the Southern Appalachians have elicited many favorable responses. SAMAB has produced a brochure and a few other informational materials but is not pushing widespread publicity yet. "We want some success stories under our belt first," Hinote says.

One such project is creation of a strategic plan for sustainable development of the Pittman Center area, a small community near Gatlinburg, Tenn. The goal is economic growth, based substantially on tourism, while maintaining the natural and cultural environment that attracts visitors. Other planned projects include monitoring of indicators of global climate change; an environmental education campaign on some aspect of global change; a study to assess the economic feasibility of cultivating the region's medicinal plants to reduce pressure on native populations; and cooperative development by the SAMAB member agencies of a course in the region on resource management for Third World countries.

Other regions are contemplating a cooperative arrangement, perhaps like SAMAB's. On Aug. 8-10, 1989, a **seminar on the MAB program** and biosphere reserves was held at West Glacier, Mont. sponsored by Glacier NP, Waterton Lakes NP, and the Coram Experimental Forest – the three biosphere reserves in the northern Rocky Mountains. The seminar introduced the MAB program to land managers, biologists, historians, and tourism and development representatives from nearby parts of the U.S. and Canada. Bjorn Dahl, superintendent of the North Carolina national forests and chairman of the SAMAB Executive Committee, described the SAMAB cooperative and its benefits to member agencies. Other speakers talked about the biological history and diversity of the northern Rockies and various management issues.

Although somewhat wary of the MAB program when they arrived, the participants went away enthusiastic.

Continued on page 17

National Academy of Sciences To Study NPS Science Programs

On Sept. 29, 1989, the NPS signed a cooperative agreement with the National Academy of Sciences (NAS) to conduct a study on "Improving the Environmental Science and Technology Programs of the National Park Service." Congress asked for the study because it believed the science program "gives the appearance of being developed in a haphazard fashion in response to specific problems and absent any general framework."

The project, to last 18 months, will be carried out by the Board on Environmental Studies and Toxicology (BEST) of the Commission on Physical Sciences, Mathematics, and Resources of the National Research Council. BEST will convene an interdisciplinary committee, which will gather information by holding workshops or public meetings, using *ad hoc* panels or consultants, and interviewing appropriate NPS personnel.

The study will address "historical development and evolution of (science and technology) programs within the NPS; the range and scope of environmental problems of concern to the NPS; the scope and organization of the current NPS science and technology programs; the extent of coordination of these programs with other NPS programs and missions; the need for monitoring, inventories and related studies to determine the status of the parks and the effects of internal and external stresses; budget and financial programming aspects of NPS science and technology programs; systems for quality control and quality

assurance of research activities; NPS outreach efforts and collaboration with the external scientific community; and options for enhancing productivity, efficiency, quality, and management relevance of the NPS science programs."

This study will "build on improvements already made (in NPS science programs) and ... recommend new regional and national goals." The NAS committee will be able to draw on a series of studies of NPS science dating back to 1933, when the NPS published Fauna Series No. 1: *A Preliminary Survey of Faunal Relations in National Parks*, by George Wright, Joseph Dixon, and Ben Thompson. Other significant studies were conducted by the National Research Council (the Robbins Report, 1963), A. Starker Leopold and others (1963), and Durward Allen and others (1971).

The findings and recommendations of the study will be presented by the NAS to the Congress and to NPS for implementation. Michael Ruggiero, Chief, Wildlife and Vegetation Division, will be the NPS project leader for the study, responsible for managing the agreement and providing liaison with the study committee.

Director Ridenour has said, "One of the things that I would hope to leave as a legacy is the creation of a solid, scientifically generated data base upon which we can make sound natural and cultural resources decisions." With the prospect of global warming and other national and international issues, that task becomes ever more complex and important. The Director looks to the NAS study as a strong helping hand in meeting the old and new challenges to our science programs.

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Napier Shelton
NPS Washington Office

Division Reorganizes

Competence, credibility, communication. These are the attributes Mike Ruggiero, Chief, wants to strengthen in the recently reorganized Wildlife and Vegetation Division. "With greater scientific competence and emphasis on developing a Systemwide view of natural resource management issues and research needs," he says, "the Division will be better able to serve both the director and the field. The new structure is intended to provide a more clearly defined focus on specific Servicewide issues and to improve communications on these issues to the regions, parks, and public."

The reorganization became effective Sept. 8, 1989. The Division, one of four under the Associate Director, Natural Resources, now consists of 22 people, organized into an office of the Chief and three branches. Hardy Pearce, Deputy Division Chief, is in charge of the Natural Landmarks Program. The Natural Resources Programs Branch (Branch Chief position currently vacant), includes the IPM and Exotics Species Program, the Endangered Species Program, and the Consumptive Uses Program, and handles other biotic resource management issues as they arise.

The Science Branch, headed by John Dennis, develops and coordinates research initiatives on issues of national and international significance, including biological diversity, global climate change, and the biological effects of acid precipitation. It also administers the Natural Resources Preservation Program (NRPP) and the Director's Special Initiatives funds and provides guidance for and participates in technical evaluation of park, Regional, and Servicewide science programs. Within this branch, Bill Gregg continues to coordinate NPS involvement in the Man and the Biosphere Program. The reorganization calls for additions of a Wildlife Biologist, Plant Ecologist, and Aquatic Ecologist to this branch.

Anne Frondorf is Chief of the Planning and Information Branch, which develops and disseminates information, both within the Service and to the public, on wildlife and vegetation issues, as well as some issues of a broader natural resource nature. Among these activities are editing a comprehensive Natural Resource Management Guideline (NPS-77), providing guidance for resources management plans, compiling Servicewide inventories of park research projects, producing bulletins on key wildlife and vegetation issues, and responding to public and Congressional correspondence on these issues.

MAB Notes (Continued from p. 16)

Tourism officials saw the benefits of cooperating to maintain health of the regional environment. A representative of the Blackfoot Tribe was delighted at the prospect of working more closely with the NPS and USFS on issues such as reestablishment of bison. The seminar also had lessons for future MAB efforts. Laurie Kurth, a Glacier NP ecologist who, as the park BR Coordinator, was one of the seminar organizers, said, "This meeting suggests that we should be talking MAB rather than biosphere reserves. 'Reserves' implies to many people that the whole region will come under preservation laws." One might add that it also suggests that the biosphere reserve concept needs better public explanation. The practical result of the seminar is that local land managers planned another meeting to explore further the possibility of establishing a regional MAB program.

On Nov. 14, 1989, in Boulder, Colo., Bill Gregg, NPS MAB Coordinator, spoke at a meeting of federal and local land managers to explore possibilities for developing a regional MAB/BR program in the **Colorado Rockies**. The present BRs in this region include Rocky Mountain NP, the Fraser Experimental Forest, and Niwot Ridge in the Roosevelt National Forest. The discussion focused on the potential benefits of using MAB as an aegis for developing a coordinated program of scientific and educational activities to help address environmental, socioeconomic, and land use issues facing the central Colorado Rockies, building upon the strengths of the existing BRs in these fields. The group decided to hold follow up discussions to further evaluate options for planning a regional program.

Napier Shelton
NPS Washington Office

GWS Conference Calls for Papers

Three main conference objectives will shape the 1990 Science in the Parks conference, sponsored by the George Wright Society and set for Nov. 12-17, 1990, at the Westin Paso del Norte Hotel in El Paso, TX:

- (1) To develop a Society platform or set of working priorities for 1990-1999, listing the five most critical and/or urgent threats to both cultural and natural resources as labeled by the Society forum;
- (2) To develop a forum position related to the cause and effect of each threat; and
- (3) To develop a 10-year (or less) strategy by which the Society can actively contribute to the mitigation of identified threats.

Oral and poster presentations should illustrate a threat or a recurring problem that threatens the preservation of cultural or natural resources in the areas of

management, research, or agency communications/organization/relationships/funding.

Threats can be of national or worldwide scope. Authors will serve as committee members assigned to each concurrent session, and these sessions will be organized according to common themes among poster/paper submittals. Committees will synthesize the findings of each concurrent session into a defined threat, each to be prioritized by the forum for platform consideration.

Prospective presenters should submit in duplicate by Feb. 15, a proposed title, with a summary of 100 words or less to Conference Co-chairman Tom Gavin at the following address: 1990 George Wright Society Conference, National Park Service, 450 Golden Gate Ave., Box 36063, San Francisco, CA 94102; FAX 415/556-2793, Attn: Tom Gavin.

Monitoring Harlequin Ducks at Acadia

By Glen Mittlehauser and Judy Hazen

The south end of Isle au Haut, part of Acadia National Park (ACAD) off the coast of Maine (see map), harbors the largest wintering population of harlequin ducks (*Histrionicus histrionicus*) in the western Atlantic. This area has been used by harlequins every winter for over 100 years (Palmer 1949) yet little is known about their ecology. Declines have been noted recently in Atlantic Canada (Goudie, 1988), but population trends in the Gulf of Maine are unknown. Harlequins in the Gulf of Maine have not been extensively studied, partially because of the inaccessibility of their wintering grounds.

Through a cooperative agreement between the NPS North Atlantic Region's Office of Scientific Study and the College of the Atlantic, a study was undertaken to provide baseline data on the population status of harlequin ducks wintering along the coastline of Isle au Haut. Results will be used to monitor future population trends and determine the importance of Isle au Haut in the wintering ecology of these ducks.

Harlequin Duck Biology

Harlequin ducks inhabit the northern hemisphere in both the Atlantic and Pacific Oceans. The population in the Pacific numbers close to 1 million birds while the population in the Atlantic may not exceed 4,000. A majority of the harlequins in the Atlantic, about 3,000, breed and winter in Iceland. The other population, made up of less than 1,000 individuals (Vickery 1988) breeds in Labrador and winters from Newfoundland south to the Gulf of Maine, with concentrations at Cape St. Mary's Newfoundland, and Isle au Haut, Maine. This population is believed to have been much larger in the early 1800s (Goudie 1989). Declines in the Atlantic population were noted before the turn of the century (Knight, 1897). Even then, biologists warned of extinction of this species in the western Atlantic. Although the harlequin was not extirpated as the years passed, the population never recovered to previous levels as did other waterfowl species in the Atlantic. Recently, declines have been noted in the Cape St. Mary's wintering group. In Canada, an extensive hunter education program has been initiated and harlequins are protected. These ducks are currently on Maine's "watch list" of possibly endangered fauna, but still are hunted.

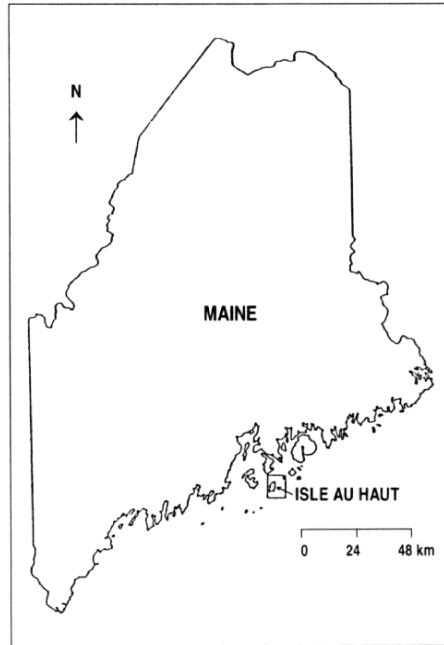
Monitoring Methodology

A series of shoreline and boat surveys was conducted along the south shore of Isle au Haut and around nearby islands. Eight shoreline surveys were conducted bimonthly from December 1988 to March 1989. Harlequin numbers were tallied by walking 19 kilometers of shoreline on the south end of Isle au Haut. Three surveys from a boat were conducted during the same time period, and included a group of small islands approximately 2 kilometers to the east of Isle au Haut. By slowly circling the islands in calm seas, using care not to frighten and flush the birds, observers using binoculars recorded counts.

In addition to these censuses, observations from a series of blinds were made, to investigate harlequin duck behavior with reference to the species' wintering ecology. Observations were made throughout daylight hours and activity budgets were determined.

Findings

Over 350 harlequin ducks winter off the south shore of Isle au Haut and the small islands to the east. This is



nearly double previous estimates for the area. This estimate probably does not represent a population increase but rather represents more intensive census techniques. Because of Isle au Haut's inaccessibility and challenging winter weather conditions, all previous surveys had been by boat or plane. Females slightly outnumbered males (1.2:1.0). The March shoreline survey showed about 11 percent of the population to be immatures.

Harlequin ducks fed 68 percent of the time observed, an estimation similar to a previous study in Newfoundland (Goudie and Ankney, 1986). Herring gulls were commonly seen stealing food brought to the surface by harlequins. Only large food items that took some time to swallow were targeted by the gulls. Although harlequins did not consistently associate with other species, they were seen occasionally with large



Atlantic harlequin duck, a beautiful and possibly increasingly rare species.

flocks of feeding common eider (*Somateria mollissima*) and black scoter (*Melanitta nigra*).

Implications for Management

This study provided baseline data on the current population of harlequin ducks near Isle au Haut. Despite challenging field conditions, shoreline surveys were shown to be feasible if combined with boat surveys to cover all ledges and small islands used by harlequins. Of course, additional data would provide more confident population counts. A closely coordinated comparison of survey techniques also would provide information useful in formulating a long term monitoring strategy. Other areas in the Gulf of Maine also should be censused regularly.

As with many preliminary studies, this one raises as many questions as it answers. What is the critical factor that makes the Isle au Haut area so attractive to harlequin ducks? If it is the remote nature of the Islands, managers must be careful to regulate increasing winter use, which would be disruptive to the birds. Because the area is important for feeding, degradation of water quality and habitat from contaminants such as oil must be avoided, and the study area should be a priority for protection should a spill occur.

What effect does hunting have on the Isle au Haut population? Under current Maine law, harlequins may be hunted from the waters surrounding Isle au Haut. Future census data may indicate the need for protection through a program of hunter education and restrictions on the taking of harlequin ducks. Although harlequins are not favored targets of hunters, some birds may be shot by mistake or by bird carvers and artists who want study skins. Canadian wildlife officials may be able to provide information on the effectiveness of their education program and hunting restrictions in harlequin protection.

Management of harlequin ducks will depend on a cooperative approach between local, state, federal, and Canadian agencies. The situation calls for development of a good communication network leading to joint evaluation of future research needs, and development of strategies for protection of this rare and beautiful bird.

Hazen is a biologist at Acadia NP; Mittlehauser is a research associate at College of the Atlantic, Bar Harbor, ME.

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NPS Joins Interagency Effort To Develop Biological Diversity

By John G. Dennis

Conservation of biological diversity currently is a major topic of discussion and concern, both nationally and internationally. Congress several years ago enacted legislation to identify biological diversity concerns that should be addressed as part of our foreign aid program. Congress currently has bills pending to develop a companion domestic biological diversity program, and last year invited the NPS Director to participate in a panel presentation of agency domestic efforts regarding biological diversity conservation.

Because of its concerns for the conservation of biological diversity, the NPS already has convened or cosponsored two workshops dealing with the topic. In addition, NPS currently is developing a bureau biological diversity plan. One result is the observation that no single agency can achieve the conservation of the nation's biological diversity by itself and that, if the nation is to succeed in conserving its natural biological diversity, all segments of society must be joined in a common effort.

In recognition of the need for interagency cooperation, and as part of its developing biological diversity program, the Service has joined an inter-agency activity to discuss the factors involved in conservation of biological diversity. This activity is being managed by the Keystone Center of Colorado. The Keystone Center is a neutral, non-profit organization dedicated to conflict resolution on issues involving natural resources, environmental quality and health, and biotechnology and genetic resources.

To facilitate conflict resolution, the Keystone Center holds policy dialogues that bring together leaders from industry, environmental and citizens organizations, government, and academia. In convening its dialogues, Keystone makes it clear that, while participants come from agencies and are provided agency support, they serve in the dialogues as individuals rather than as formal representatives of their organizations.

The Dialogue on biological diversity developed by the Keystone Center currently is planned to include three to six plenary sessions and a number of work group meetings spread over an 18 month period that started in March, 1989. The Service has agreed to participate in this dialogue both by providing funding through the Forest Service and by designating four NPS participants (Dr. F. Eugene Hester, Dr. Michael A. Ruggiero, Dr. John G. Dennis, and Supt. John F. Byrne) who will attend the meetings and develop written materials as appropriate.

The Service participated fully in the first dialogue (March 29-31, in Washington, DC) together with personnel from the Forest Service, Bureau of Land Management, Fish and Wildlife Service, Environmental Protection Agency, U.S. Navy, 7 Congressional Committees, Office of Technology Assessment, 14 environmental or trade organizations, 6 resource utilization companies, and 2 universities. This first meeting developed agreements on:

- a working definition (biological diversity is the variety of life and its processes);
- an initial focus for the dialogue (looking at the programs and activities of major federal land management agencies on federal lands that may affect biological diversity);
- five objectives to be sought to maintain biological diversity;
- a tentative outline of what the final report would contain;

- assignments of participants to one of two work groups (Policy and Coordination, Data and Research) and development of tentative work plans for each of the two work groups; and

- scheduling of two work group meetings and the next plenary meeting.

The first working group meeting (May 22, 1989 in Washington, DC) was the Policy and Coordination Work Group, to exchange information about existing policies, programs, and activities of the Dialogue's member organizations which are supportive of the protection and maintenance of biological diversity. As background for this meeting, the Service submitted Chapter IV of the Management Policies, a staff paper discussing the Service's mandate with respect to biological diversity, and a summary of existing Service activities that relate to four objectives established by the Dialogue.

The second working group meeting (June 5-6, 1989, in Denver) was the Data and Research Work Group, to continue development of the group's work plan regarding inventory, monitoring, and research aspects of protection of biological diversity. The group took advantage of its Denver meeting site to engage in a half day field trip to Rocky Mountain NP to observe some examples of Service research on biological diversity preservation con-

cerns, and to learn first hand some of the real constraints that exist in the practicality of concretely applying in the field concepts that are developed in the abstract by the Dialogue.

The second plenary session (July 10-12, 1989, in Keystone, Colorado) carried out the following steps. It received reports on each of the previous work group meetings. It split the Policy and Coordination Work Group into an Agency Policy Work Group and a Coordination Work Group, and conducted sessions of all three work groups. It reexamined the scope of the Dialogue in response to concerns raised as a result of work group discussions and reaffirmed the Dialogue purpose to focus initially on programs and activities of major federal land management agencies on federal lands as they affect biological diversity, with recognition that federal agencies will need a broad perspective.

At this stage, the Dialogue has passed through the phase of introductions of what the various agencies are doing and now is generating ideas and new ways of viewing biological management situations. It is likely that the current brainstorming phase will extend through several more sets of meetings.

Dennis is Chief, Science Branch, NPS Wildlife and Vegetation Division.

meetings of interest

1990

March 1-2, HIGH ALTITUDE REVEGETATION WORKSHOP, at the Fort Collins Marriott Hotel, Fort Collins, CO; Contact: Mark Theisen, 1210 Citizens Parkway, Morrow, GA 30260; 800/845-4453

March 20-24, FIRE AND THE ENVIRONMENT: ECOLOGICAL AND CULTURAL PERSPECTIVES, an international symposium to be held in Knoxville, TN, multi-sponsored including NPS, U/TN, USFS, and the Society of American Foresters. Contact: Fire Ecology Symposium, Dept. of FW&F, U/TN, Knoxville, TN 37901-1071, (615) 974-7984.

April 29-May 3, SOCIETY FOR ECOLOGICAL RESTORATION, 2nd annual conference, at the Sheraton International Hotel, Chicago's O'Hare airport. Program will explore the state of the restoration art as it applies to key environmental issues and will include special events to facilitate communication among restorationists, decision makers, and the general public. Feb. 15, 1990 is deadline for submission of contributed paper abstracts. Contact: Dave Egan, U/WI Arboretum, 1207 Seminole Hwy, Madison, WI 53711; 608/262-9547.

May 8-16, THE BERGEN CONFERENCE; ACTION FOR A COMMON FUTURE, in Bergen, Norway. Contact: Ministry of Environment, 1990 Conference Secretariat, PO Box 8013 Dep., 0030 Oslo 1, Norway.

May 16-19, THIRD SYMPOSIUM ON SOCIAL SCIENCE IN RESOURCE MANAGEMENT, at Texas A&M University. Contact: James Gramann, Dept. of Recreation and Parks, Texas A&M, College Station, TX 77843; (409) 845-4920.

May 23-29, CONGRESS ON MARINE TOURISM, a symposium and workshop on balancing conservation and economic development, sponsored by Sea Grant College Program, East-West Center, and the Pacific Basin Development Council. Contact: Dr. Jan Auyong, Marine Tourism Congress, Sea Grant Extension Service, U/HI at Manoa, Honolulu, HI 96822; (808) 948-8191; FAX: 808/955-6950.

Nov. 12-17, SIXTH CONFERENCE ON RESEARCH IN THE NATIONAL PARKS AND EQUIVALENT RESERVES, at the Westin Paso del Norte Hotel, El Paso, TX; Contact: Conference Committee at 415/556-1866.

1991

Nov. 4-8, THIRD GLOBAL CONGRESS OF HERITAGE INTERPRETATION INTERNATIONAL, in Honolulu, to explore how effective interpretation can help protect natural and cultural heritage while providing meaningful and memorable experiences for residents and visitors. Contact: Gabriel Cherem, EMU Geography & Biology, Ypsilanti, MI 48197; 313/487-0218, or Ray Tabata, UH Sea Grant, 808/948-3191.

Wupatki Grazing Terminated

Editor's Note: Larry Henderson, Superintendent of Wupatki-Sunset Crater National Monuments in Arizona, submitted this account of "a recent success story."

By Steve Cinnamon

After more than a century, cattle grazing has been terminated in the 15,000 acres of the western portion of Wupatki National Monument. Cattle grazing began in the late 1880s as three Babbitt brothers left Cincinnati, Ohio and began ranching operations in the Flagstaff, Arizona. Their operations included grazing public domain on what was later to become Wupatki National Monument.

In 1924, the monument was established as two separate units totaling 1620 acres to "...reserve prehistoric ruins built by the ancestors of ... the Hopi or People of Peace...". In 1937, the monument was expanded to include an additional 33,631 acres. The expansion was created out of the public domain land grazed by the CO Bar Cattle Company. The park entered into agreements with the ranchers to graze according to existing park service guidelines. Provisions of the first grazing permits included 500 head of cattle from the period of December to May to utilize snowfall for a water source.

As the ranch management developed water sources, the grazing season was shifted to mid-November through mid-April. The three brothers of the corporation were given a lifetime permit but began negotiations for a term permit after one brother died and another was in failing health. By 1958, the Park Service had denied issuing a 50-year permit but were willing to accept a 20-year non-renewable permit in addition to an 800-acre exchange to 'even' out the boundaries. The 1963 Memorandum of Understanding between the park and ranch cited the non-renewable provision of the permit, the land exchange, a permanent 200-foot easement across CO Bar Ranch to remote sections of the monument, and provision for a fenced stock drive-way to allow cattle access from Antelope Prairie into Wupatki Basin.

With the permit slated to expire in 1983, a meeting was requested by the ranch management in October, 1981. The ranch management presented an argument of not being prepared to absorb the loss of 15,000 acres of winter range and requested a five-year extension of the permit. Former Director Dickenson granted the request adopting the provisions of the 1963 agreement. One alteration was that the grazing season was shifted to mid-October through mid-March for 500 head of cattle. This action was undertaken at the request of Southwest Regional Chief Scientist Dr. Milford Fletcher to reduce the competition between livestock and pronghorn antelope for spring forage.

Range condition had improved dramatically from 1977 baseline data established by Northern Arizona University. Researchers had established range transects and erected four grazing enclosures to determine range condition as part of their four-year Natural Resource Survey. Clipping plots and trend plots, which were begun in 1981 and conducted yearly, indicated the range had improved from a poor classification to an upper good/excellent condition. Photographs verified the improvement recorded by line intercept transects.

In order to insure that a second extension would not be granted, Resource Management Specialist Steve Cinnamon began a monitoring program to determine the effects of livestock grazing on surface deposits of cultural artifacts, primarily potsherds. The strongest argument to deter future grazing was the damage to

cultural resources and its direct conflict with the park's having been established to preserve such prehistoric features. Photoplots of potsherd destruction by trampling verified the surface destruction. An inventory type archeological survey across the monument also recorded damage to prehistoric sites resulting from livestock grazing activity.

In December 1985, the CO Bar Ranch Management requested a meeting with park management. They offered an exchange of 3000 acres of land for a new 25-year grazing permit. They also reminded park officials of the potential for developing a gravel deposit located east of Crack-in-Rock, which would require improvement of the road and great physical disturbance to the prehistoric landscape in that area.

Park management prepared a threats memo to Southwest Regional Director John Cook, outlining the situation. Bruce Anderson, Southwest Region archeologist, who conducted the archeological inventory, verified the lack of unique or rare archeological remains in the land to be acquired. Correspondence with the ranch management began to stress the conflict of grazing and the Service's mandate of preserving prehistoric resources. A briefing statement highlighting the administrative decisions of the grazing program over the past 50 years was prepared for the Directorate staff. Then NPS Director William Mott stood by the park's recommendation to terminate grazing.

The permit expired in March of 1988. The park's boundary remained unfenced. The ranch manager approached the Park Service and offered to pay for trespass grazing for the winter season of 1988-89. Cinnamon established a monitoring program to have patrol personnel count cattle. A bill of collection was prepared for the ranch management adopting the 43 CFR non-willful trespass rate of \$8.42/AMU* after establishing a justification with the Southwest Regional office.

In April, 1989 notice was received that NRPP funding was available to begin fence construction. A budget outlining the expenditure of \$70,000 was established. Military surplus equipment air compressors, 1 ton trucks, and pickups were acquired from Luke AFB surplus yard. All material had been purchased with year end funds from previous years. A day labor crew

*AMU = Animal Month Unit, which can be one cow with calf, one horse without foal, or 5 sheep.

began work in early May. The orientation and training session included movies on equal opportunity, a tour through the parks and a background of the grazing activities in the monument. Logistic bugs were worked out during the first week. The 7-person crew included one GS-4 Ranger to assist with survey and monitoring work, three maintenance workers and three laborers.

As work progressed, the crew found their strengths and established a system of using the air compressor to drill brace post holes in the morning, and t-post holes on line in the afternoon. They were able to construct an average of 1/4 mile of four strand fence a day. Considering all holes were having to be drilled, it was much faster than anticipated.

In mid-June, the park received word that an additional \$50,000 was available if it could be spent. Cinnamon programmed for a second five-man crew, five miles of material, equipment rental and GSA vehicles and a contract for an estimated 11,000 feet of fence for the stock driveway. The second crew arrived in late June and assisted in the completion of a critical 9-mile stretch across Antelope Prairie, reaching Highway 89 on the western boundary of Wupatki on August 2. A field celebration included Cinnamon and Superintendent Henderson pounding the final post and clipping the last four strands of wire on the north boundary fence.

The crew continued to fence the remaining 7 miles of boundary. As of late September they have completed 13 miles and have 3 remaining. Dr. Fletcher of the Southwest Region is providing an additional \$15,000 on October 1 to continue the crew in hopes of completing the boundary.

"I consider it a rare opportunity for a Resource Management Specialist to be involved in all phases of the Wupatki grazing program," said Cinnamon. "I have had the opportunity to work with the regional office personnel, fellow resource managers, ranchers, contractors, and staff and to see this project through. It could not have been completed without Dr. Fletcher's arguing for a securing funding. The day labor crew has been great. They have completed all fence work to date without an injury. Communication between divisions within the park improved as maintenance personnel helped complete line survey, cattle guard installation, material transport and vehicle servicing. The completion of this project is the highlight of my eight years at Wupatki."

Cinnamon is now Resource Management Specialist with the Midwest Regional Office.



Driving the last fence post. Steve Cinnamon, Resource Management Specialist and Larry Henderson, Superintendent, Wupatki & Sunset Crater NM.

Blanding's Turtle Research at Roosevelt-Vanderbilt NHS

By David J. Hayes

In the spring of 1988 a two-year effort to determine the population status of the Blanding's turtle (*Emydoidea blandingii*) was launched at Roosevelt-Vanderbilt NHS (Hyde Park, Dutchess County, upstate New York). Blanding's turtles are listed as threatened by the New York State Department of Environmental Conservation. Scattered populations are present in the St. Lawrence and Hudson Valley regions, with the heart of the species' range located in southern Ontario and the Great Lakes states.

The study took place at Eleanor Roosevelt National Historic Site (known as "Val-Kill"), located in the Fall-Kill Creek watershed. In the 1920s, the Roosevelt family constructed a small dam on the creek that formed a pond and several acres of marsh and shrub wetland. Eventually, siltation and deposition decreased the amount of open water available for swimming, fishing, and boating, prompting Franklin D. Roosevelt to have the main pond area dredged periodically.

In the decades following the last dredging, up to 9 feet of silt has accumulated. Lower water levels and rising nutrient loads have allowed the establishment of native emergent aquatic plants as well as Purple Loosestrife (*Lythrum salicaria*), an invasive non-native perennial. As the growing season progresses, plant growth reduces the amount of open water and changes the character of the historic landscape.

In order to retain the historic scene, the National Park Service (NPS) is considering dredging once again. Here the clash between cultural resource integrity and natural resource protection becomes acute, since the act of dredging results in considerable site disturbance and a potential temporary drawdown of the water level. While dredging is unnecessary from a strict biological perspective, it becomes important when considering the park's need to provide an accurate portrayal of the historic landscape to the public. To determine what effects this action might have on Blanding's turtles, which were known from three specimens to be present since 1979, a population census was initiated.

Blanding's are medium sized turtles with a high-domed, blackish-gray carapace covered by white or gray streaks. Obvious field marks are the solid lemon-yellow chin and throat, prominently displayed when the turtle basks in the sun and stretches its very long neck. Little is known of their behavior. Like box turtles (*Terrapene* spp.), the Blanding's has a hinged plastron allowing it to close its shell as protection against predators. We found the species to be extremely wary and difficult to approach, diving to the bottom at the hint of human intrusion, and not reemerging for several minutes if at all. It was necessary to use 10X binoculars or a 25X spotting scope to locate basking specimens.

Blanding's are long-lived; individuals present today may well have been alive within the historic period (ca. 1962). Although determining age is somewhat conjectural due to plastron wear, all captured Blanding's turtles were estimated to be between 15 and 25 years old, theoretically placing them in the reproductive population.

A primary objective of the project was to determine which areas in the park are utilized by the Blanding's turtle. During spring, early summer, and fall, funnel traps baited with canned sardines were placed in the Fall-Kill wetlands complex as well as all other potential habitat, including several permanent and ephemeral

woodland ponds. After capture, turtles were marked with individual file-notched codes on the marginal scutes, measured, and released. Over 300 trap-days of effort in each of the two years of the study indicate that Blanding's turtle is not likely to be found in the open, deepwater sections of Fall-Kill Creek. No individuals were actually trapped in the stream channel, but one Blanding's was trapped in wetlands directly connected with it. Most captures took place in partially shaded woodland pools with abundant aquatic vegetation.

In addition to Blanding's turtles, the non-selective nature of the traps allowed us to census all turtle species. An auxiliary survey of other reptiles and amphibians was conducted concurrently with the turtle research. Of special note were large populations of Spotted Turtle (*Stemmys guttata*) and Jefferson's Complex Salamander (*Ambystoma jeffersonianum* x *laterale*), as well as the presence of Spotted Salamander (*Ambystoma maculatum*) and Wood Turtle (*Clemmys insculpta*), all listed as "Species of Special Concern" by New York State. In all, 30 species of reptiles and amphibians were documented in the park.

What have we learned?

The primary objective of the study – to determine which areas are inhabited by Blanding's turtles – was accomplished. Blanding's turtles are known to occur at low densities throughout their range, giving unusual importance to the survival and reproductive success of individual turtles as components of the population. This was borne out at Val-Kill, where the population seems to be small but stable. One individual has been captured in the same general location three out of the last six years. Individuals captured as part of this study have been trapped previously on private, adjacent land, indicating home ranges in excess of 1300 meters. Literature had reported a rather small home range for Blanding's turtles of less than 100 meters. (Ernst, C.H., and R.W. Barbour, 1972).

There is the possibility that traditional dredging in the main impoundment will have a negative impact on the population. With such low densities, individual turtles take on unusual importance, and any work must be done with this in mind. The NPS must make every effort to ensure that Blanding's turtle habitat is not adversely affected by our actions. Alternative means of removing the silt that has accumulated on the pond bottom will be explored, and the full range of environmental compliance requirements will be satisfied

before any modification to the site is attempted.

What do we still need to know?

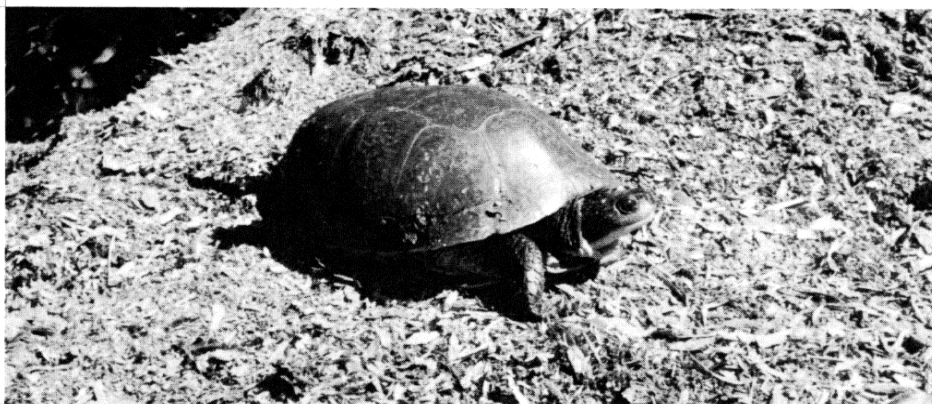
The study did not produce any information on breeding activity or nest locations. Without radiotelemetry data, movements outside capture zones are unknown. Perhaps the most crucial remaining questions: why aren't we capturing any young turtles? Is the population growing, stable, or declining? What impacts do external land use practices and local development have on the population? What is the long-term cumulative impact resulting from the loss of small wetlands over an extensive area? As usual, the questions generated by this study outnumber the answers.

However, data from this project have produced park-specific information that will be of great use to site managers. It has allowed us to identify critical habitat for Blanding's turtles and other rare and threatened reptiles and amphibians in the park. It has resulted in modifications to maintenance mowing and hay harvesting schedules. The study has contributed to baseline knowledge of Blanding's turtle in the region, with data and information shared between the NPS and other researchers working with this species.

It also has helped to raise public awareness of the plight of Blanding's turtle. The Hudson Valley population is on the eastern fringe of this species' range, but there is considerable concern about the future of the Blanding's turtle even in the heart of its distribution in the Great Lakes region. The primary threat appears to be habitat loss. The Blanding's turtle population on NPS lands in Hyde Park, although small, provides a stable and relatively well-protected study group for future research. However, the ability of individual turtles to move long distances outside the park onto private land, possibly in search of nest sites, is a concern.

The study was coordinated by Resource Management Specialists Robert Cook of Gateway NRA and David Hayes of Roosevelt-Vanderbilt NHS. Most of the field work was completed by Michael Klemens of the American Museum of Natural History (1988) and Marla Emrich of Bard College (1989). Members of the park's Visitor Services staff and Volunteers-in-Parks Program also assisted with field work. Klemens prepared an interim report based on data from 1988; Hayes will produce a final report later this year. Support was provided by the Office of Scientific Studies, North Atlantic Region, as well as park base funding.

Hayes is a Resource Management Specialist at Roosevelt-Vanderbilt NHS.



Blanding's Turtle. This 15-year-old female shows the high-domed, "army helmet" shell characteristic of the species. Her picture was taken on Oct. 31, 1989.

Hurricane Hugo Damages Natural Resources At Virgin Islands National Park...

By Caroline Rogers
Research Biologist
Virgin Islands National Park

Hurricane Hugo hit the U.S. Virgin Islands on Sept. 17-18, 1989 with sustained winds of about 140 mph and reported gusts of up to 200 mph. This paper summarizes the observations made by the Park's Research Biologist (C. Rogers), a University of Wisconsin graduate student (G. Ray), the Chief of Interpretation (C. Weikert), Division of Fish and Wildlife staff (J. Beets, A. Friedlander), a University of the Virgin Islands marine scientist (L. Muehlstein), and a Northeastern University marine biologist (P. Edmunds).

Coral Reefs

The coral reef off Yawzi Point, Lameshur Bay, on the south side of St. John has been the focus of long-term studies on fish populations and coral communities. On Oct. 2, C. Rogers and C. Weikert Scuba-dived on the reef to take photographs and make observations. They noted extensive damage to the study area to its maximum depth of about 40'. While some large pillar corals (*Dendrogyra cylindrus*) remain intact, many were lying on their sides and/or had lost several of their branches ("pillars"). Some of these branches are 3' long and 8-10" in diameter. Head corals over 3' across had been overturned. Piles of coral rubble had collected in sand channels in the reef. Sea fans and other gorgonians had been ripped off their bases and were lying flat on the substrate. Some coral colonies had white patches which appeared to be from abrasion by sediments.

If five 20 m long transects established by park researchers last January can be relocated, they can be analyzed to provide a comparison of the coral communities before and after the storm. Some of the shallow patch reefs in Greater Lameshur Bay have been demolished. In shallow areas fringing the shoreline, the abundant encrusting fire corals have lost all their branches. One study site on a reef in 9 m of water, east of Yawzi Point, was essentially reduced to flat pavement.

C. Rogers snorkeled at Haulover Bay on the northeast side of St. John and found extensive damage. Large elkhorn colonies, some previously dead, were fractured. Huge piles of coral rubble lie in depressions in the bottom. Colonies over 3' across were flipped over, causing smothering of live coral tissue.

The northern and northwestern bays of St. John are the most heavily visited. C. Rogers and C. Weikert snorkeled in Hawksnest and Leinster Bays and found little damage from the hurricane. Some corals fringing Waterlemon Cay in Leinster Bay were smashed when boats cut loose from their anchors and went up on the island. A plume of silt-laden water extended throughout Hawksnest Bay and out towards Johnson's Reef the day after the hurricane. Runoff was noted elsewhere as well. However, while visibility was poor for several days after the storm, accumulations of sediment particles were not seen on living corals at any of the sites checked to date.

Seagrass Beds

Seagrass beds in Lameshur Bays have large "blow out" areas where storm seas scoured out the seagrass

plants. Some areas of about 30m x 20m were excavated to a depth of 40-50 cm. Seagrass root systems were cast up in large mounds on the beaches of Little Lameshur, Greater Lameshur, and Salt Pond Bay. Dead reef fish and sponges were found in the seagrass debris.

Fish Populations

On Sept. 29, J. Beets and A. Friedlander did fish censuses in Lameshur Bay and noted an apparent decrease in species and abundance of fish. Further analysis and censusing is required to determine the effect of the storm on the fish populations. Some dead fish washed up on the beaches as noted above.

Mangroves

Mangrove communities in general sustained heavy damage. Black mangrove trees in salt ponds and swamps near Leinster Bay, Francis Bay, Coral Bay and Reef Bay were uprooted by the hurricane winds. Red mangrove trees fringing the shores of Coral Bay suffered damage only in a few places where boats had been swept on to the shore.

The Forests

A more thorough assessment of the damage sustained by the island's forests will be made in the future after the scientists who have been conducting long-term studies here have a chance to examine their study plots. Many old, large trees on the island were destroyed. The day after the hurricane, some hillsides showed alternating green and brown areas, the green

indicating trees which had suffered less damage, the brown the bare twigs and branches of trees stripped of their leaves. Some windward facing slopes exhibited swaths of complete destruction, suggesting that tornadoes had been generated by the hurricane. Within a week of the storm, two exotic species began leafing out.

Bottomland (basin) moist forests, perhaps more vulnerable because their canopies are taller than surrounding vegetation, were hard hit on the south and north sides of the island. The gallery forests (along gullies) suffered less damage. An estimated 30-40 percent of the trees in dry (deciduous) forests on the south side sustained damage, with major branches broken off. Less damage occurred on the leeward north side. Numerous emergent trees in the dry woodland forest were blown down, and many lost leaves and branches. However, most trees broken off show early signs of enhanced lateral growth. In the semi-arid areas (cactus/scrub) relatively limited effects of the storm were noted. Some cacti were broken off or toppled over. Leaves, branches and even some trees were observed by scuba divers in water down to 40'.

The hurricane hit when many species of trees were at the peak of their fruiting. This loss of fruit from numerous woody species represents an abrupt reduction in food supply for island wildlife, particularly for birds and bats. This prolonged interruption in available food could further reduce animal populations subjected to this severe storm.

GIS notes

Four Park Service people presented papers on "Applications of GIS in National Parks" at the International Geographic Information Systems Symposium, March 1989, in Baltimore, MD. Sharon Shin, GIS Division (Denver) described using GIS technology to help assess the impacts of current and proposed mining activities in Wrangell-St. Elias and Yukon-Charley Rivers NP and Preserves. Dave Buker, Everglades NP, discussed using GIS technology to aid research on endangered and exotic species, water quality and quantity, and wading bird populations. Jeri Hall, George Washington Memorial Parkway, described the anticipated contribution of GIS technology in managing submerged aquatic vegetation, exotic plant species, maintenance, cultural resources, and landscape appearance. Alison Teetor, Shenandoah NP, discussed applying GIS technology to evaluate the effects of forest defoliation by gypsy moths at Shenandoah.

GRASS GIS Users Conference

The Fifth Annual GRASS GIS Users Conference was held Nov. 6-9, 1989, in Alexandria, VA. Over 200, including 18 from the NPS, attended. Four NPS people presented papers. Maury Nyquist reported on the status of the NPS GIS program, in particular, the installation of GRASS software. Susan Stitt described tech-

niques for processing USGS digital elevation data. Bruce Powell explained enhancements to the software he has recently made. I described major improvements we intend to make to GRASS's graphics capabilities, particularly in the vector and interactive environments.

RT 90

Many of you have by now seen an announcement I distributed about RT 90 (Resource Technology '90), a conference in November 1990 in Washington, DC, on contemporary and advanced technology for resources management. I am beginning to receive calls about the special interest area I am arranging on using up-to-date information technology to help manage parks and protected areas. As I said in my distribution memo, the conference "should prove to be an excellent and rare opportunity to meet and share ideas with international colleagues about a very contemporary and useful subject." To facilitate NPS attendance I am looking into having the conference offered as an NPS training opportunity, like the NPS GIS workshop in Luray, VA, in October 1988. More on this later.

Harvey Fleet, Chief
Digital Typography Branch
NPS GIS Division
Denver, CO

...and Congaree Swamp National Monument

Damage from Hurricane Hugo to the Congaree Swamp National Monument

By Rebecca Sharitz and Francis Putz

To assess the forest damage in the Congaree Swamp National Monument attributable to Hurricane Hugo, trees >20 cm dbh (diameter at 1.4 m or above butt swell) were censused in both bottomland hardwood forest and cypress-tupelo sloughs. The 0.2 ha plots (20 x 100 m) were located at random in old-growth forest in the southeastern portion of the Monument south of the confluence of Toms Creek and Running Lake, south of Wise Lake, and along the boardwalk to Weston Lake. Twenty-one plots were censused (total area = 4.2 ha), 12 in bottomland hardwood forest and 9 in cypress-tupelo sloughs. To improve the assessment of damage to *Pinus taeda* trees in the vicinity of the Ranger Station, we sampled 100 *P. taeda* trees >20 cm dbh within 20 m of the boardwalk and along the road toward Weston Lake.

Each tree in the plots was identified to species, measured (dbh), and classified as having suffered no serious damage, uprooted, snapped, bent or having lost portions of its crown (25-50, 50-75, and >75 percent). We also noted whether the trees showed obvious signs of having suffered previous damage, the presence of heartrot, the height of breakage, and the compass direction of fall.

Results and Discussion

Cypress-Tupelo Sloughs

Although Hurricane Hugo caused substantial losses of leaves and small branches, only about 19 percent of the trees in the cypress-tupelo sloughs suffered serious damage (Table 1). Uprooting was particularly uncommon in the sloughs. This was surprising because trees in sloughs are generally thought to have relatively shallow roots systems, due to anaerobic soil conditions. Although there were 12 uprooted trees in the 9 plots, none were bald cypress (*Taxodium distichum*) or water tupelo (*Nyssa aquatica*). Furthermore, during the 8 days of field surveys, we observed only one uprooted cypress tree anywhere in the Monument. A recent study of the rooting patterns of bald cypress trees in Florida showed that the trees developed several "sinker" roots that penetrated to greater depths than the rest of the root system (K. Ewel, Univ. of FL, pers. com.). Such a root system may effectively anchor bald cypress trees in the relatively unstable soils of the sloughs. Crown breakage in water tupelo in the sloughs may in part account for the infrequency of uprooting and snapping in this species. After a tree loses leaves and branches, its wind resistance is substantially decreased and the probability of more serious damage is consequently reduced. In the case of cypress, serious damage may be rare both because the trees have strong wood and because cypress trees normally display little leaf area relative to trunk diameter; this too results in low wind resistance.

A large proportion of the trees in cypress-tupelo swamps had obviously suffered severe wind damage previous to Hurricane Hugo. This damage and subsequent recovery left its mark on the crown and bole structure of many of the trees, particularly larger water tupelo trees. Mechanical damage is likely to have contributed to the incidence and severity of attack by heartrot fungi. Trees with heartrot are very susceptible

to further damage even if the crown resprouts. Breakage and resprouting seems to be a major process in the dynamics of this forest.

Among commercial forest species, both bald cypress and water tupelo are rated as relatively resistant to hurricane-related damage (Barry et al., 1982). Along with palm and live oak, bald cypress is ranked as highly resistant to uprooting and breakage. Tupelo is less resistant than cypress but is ranked as less prone to uprooting and breakage than are most oaks, pines and hickories. Observations in forested areas of the South Carolina coastal plain (Francis Marion Forest, Santee Experimental Forest) have also revealed far more extensive damage to pine and oak forest than to cypress-tupelo stands.

Bottomland Hardwood Forest

Approximately half of the trees in the plots in the bottomlands of the Congaree National Monument suffered serious damage but only about 25 percent were uprooted or snapped (Table 2). In contrast to water tupelo and bald cypress, bottomland hardwoods seem equally prone to being uprooted and to suffering stem breakage. The major short-term effect of Hurricane Hugo in both forest types, however, was the loss of much of the foliage and many small branches.

The among plot variation in the proportion of damaged trees was very large. In the bottomland hardwoods, densities of trees ranged from 34-64/0.2 ha and the proportion of uprooted and snapped trees ranged from 4-50 percent. This extreme heterogeneity was undoubtedly due to the specific paths of Hurricane Hugo and the cyclones it probably generated.

Trees that had recovered from serious damage prior to Hurricane Hugo suffered a very high probability of sustaining subsequent damage (Table 3). Architecturally unstable branching patterns of resprouted trees, heartrot and insect damage are probably responsible for this heightened susceptibility to damage of previously damaged trees. The effects of the process of repeated breakage and resprouting on forest structure and composition will be important to monitor as the forest recovers from Hurricane Hugo.

Pinelands

Large *Pinus taeda* trees in general and those in the vicinity of the Ranger Station in particular received special attention. Although two of the bottomland forest plots were near the boardwalk, we increased the accuracy of our assessment of pine damage with a special census. Pines >20 cm dbh within 20 m of the boardwalk and the road to Weston Lake were measured (dbh) and classified by damage type. A total of 100 trees was censused, of which 46 had escaped serious damage (Table 4). Uprooting and snapping were about equally common (21 and 28 trees, respectively). Most of the broken (snapped) trees had heartrot, but we suspect that many of the undamaged and uprooted trees were likewise infected.

Forest damage was severe in areas where pines were common. This is mostly because when a large pine was either uprooted or snapped, it caused a great deal of damage to its neighbors. Three pines fell across the road or trails and consequently were cut by the Monument staff. Examination of the cross-sections of three trees (aged about 156, 157, and 180 years) revealed extremely slow growth rates (<<1mm/year) during the last two decades.

In the absence of fire, we doubt that even the extensive damage of Hurricane Hugo will result in success-

ful pine regeneration. Where the canopy was radically opened, the understory of switchcane (*Arundinaria gigantea*), vines, shrubs, and small trees was quite dense even immediately after the storm. Furthermore, thick mats of litter and organic matter still cover the ground except where mineral soil was exposed by uprooted trees. Fire is a distinct possibility, however, especially now with the heavy fuel loads in much of the bottomland forest.

Conclusion

It became evident in the course of our damage survey that the forests of the Monument have suffered severe storms several times during the last few decades. Earlier this year (16 June 1989), for example, the forest was severely damaged by a thunderstorm. We expect that there will be changes in tree species composition in the bottomland hardwoods and particularly where large pines once dominated the landscape. These changes will be evident, however, only if permanent inventory plots are monitored for tree growth, death, and recruitment over the next decades.

Sharitz is with the Savannah River Ecology Lab, Aiken, SC 29802; Putz is with the U/FL Botany Dept., Gainesville, FL 32611-2009.

Reference

Barry, Patrick J., Robert L. Anderson and Kenneth M. Swain, SR. 1982. How to evaluate and manage storm-damaged forest areas. Forestry Report SA-FR20. September 1982. USDA Forest Service. 15p.

Buck Island Reefs Hard Hit by Hugo

Biological Technician Zandy-Marie Hillis reports that Hurricane Hugo left major impacts on Buck Island Reef National Monument (BUI). Park rangers patrolling the southeast forereef of the Underwater Snorkeling Trail found the reef crest piled one to two feet high with dead coral rubble. Large branches of elkhorn coral (*Acropora palmata*) were broken, showing 8- to 10-inch cross-sections of white skeleton. Extensive breakage was also observed among the other corals in the area. Fire coral (*Millepora complanata*), normally erect along the reef crest, was crumbled and piled up along the foot of the forereef. However, all underwater interpretive signs except one were still in place, and all visitor moorings were still intact.

Patrols of the terrestrial vegetation on Buck Island, on the other hand, revealed extensive damage. All adult trees, including large tamarind, turpentine, sea grape, acacia, manchineel, frangipani, barrel and organ pipe cactus were affected by the storm, in the form of broken limbs, shattered trunks, and trees completely uprooted, eroded out and laid down. Manchineel trees were laid down parallel along the north shore like match sticks, up to 20 to 30 trees deep in areas. The south shore, in particular, was affected by a high storm surge that cut 10 to 15 feet deep into the permanent landscape, eroding out adult trees.

The hawksbill turtle nesting beaches at BUI were also greatly altered by the hurricane. The nesting beaches, shoreline, and beach forest to the southeast were severely eroded, up to 15 feet in some areas. All shoreline trees along the northshore nesting area (predominately manchineel) have been laid down, parallel to the shore, blocking access to the normal hawksbill

Continued on back cover

Buck Island (Continued from p. 23)

nesting areas in the beach forest. In addition to the wall of fallen trees, the storm erosion increased the height of the beach berm by up to 3 feet. This has effectively closed these areas to hawksbill nesting.

The effects of Hurricane Hugo on hawksbill nesting success is already apparent. The obstacles along the southeast and northshore areas have pushed the hawksbills to nest on the open beach (West Beach) which is not the normal preferred nesting habitat. Also, it is estimated that more than 80 percent of the 55 confirmed nests on the beach, incubating prior to Hugo, were lost in the storm or unrelatable due to changes in the landscape and beach profile. Daytime patrols for nesting activities and nest success determination will continue on a boat-available basis for the rest of the nesting season, December-January 1990.

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In the Next Issue:

"Electric Fence Enclosure Fails to Confine Feral Goats" by Dan Taylor; "Humpback Whales of Glacier Bay: An Update" by Gary Vequist; "Great Basin: Our Newest National Park" by Marty Lee and Ed Starkey; "Peregrines of Grand Canyon" by B. Brown, S. Carothers, S. Hoffman, and R. Glinski; "Plant Diseases in Hawaiian Parks: Prevention or Preservation?" by Don Gardner; and "Marine Debris Monitoring Program," by Nicholas Chura.